Overview of Federal Motor Carrier Safety Administration Safety Training Research for New Entrant Motor Carriers

U.S. Department of Transportation
Federal Motor Carrier Safety Administration

July 2015

FOREWORD

The Federal Motor Carrier Safety Administration (FMCSA) is required to establish initial requirements for determining if a motor carrier is fit to operate safely. Section 210(b) of the Motor Carrier Safety Improvement Act (MCSIA) requires a rulemaking to establish minimum requirements for new entrant motor carriers to obtain an interstate U.S. Department of Transportation (USDOT) number. The Moving Ahead for Progress for the 21st Century Act (MAP-21) requires that FMCSA issue a rule mandating that a new entrant applicant pass a proficiency examination and other requirements as necessary to ensure the applicant understands the safety regulations before being issued an interstate USDOT number.

Existing theory, testimonials, and empirical data document that safety performance is substantially better for those vehicles and drivers of motor carrier companies that embrace a safety culture. This report presents empirical safety data from both a simple, first-generation, instructor-led training curriculum applied in 2005–06 and a more detailed second-generation curriculum applied in 2010–12. Results of both corroborate the theory that training and testing new entrant motor carriers under the right conditions effectively fosters their adoption of a safety culture.

Diffusion theory explained results achieved by the first-generation curriculum and accurately predicted results for the second-generation curriculum. It thus provides guidance on how to be more effective in future training and testing. Another finding is that FMCSA could meet the MAP-21 new entrant requirements by deploying such training and testing for new entrant motor carriers nationally through a blended, standardized curriculum.

This report explains how a blended third-generation curriculum should be developed. It is critical that the training be applied to owners/managers of new entrant motor carriers. The management of a company will not understand the importance of a safety culture if a consultant or low-level employee completes the training and testing.

Interested audiences include safety advocacy groups, the highway safety statistics community, motor carrier industry groups, motor carriers, motor carrier training institutions, and FMCSA.

NOTICE

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16. Abstract

New entrant motor carriers generally are very small and have poorer safety performance than more established carriers. This may be because very small carriers do not have the resources for a safety department or a safety official on staff. To help address this, the Moving Ahead for Progress in the 21st Century Act (MAP-21) amended the Motor Carrier Safety Improvement Act (MCSIA) of 1999 new entrant requirements to mandate a proficiency examination and other requirements as necessary to ensure new entrant applicants understand the safety regulations before issuing the applicant an interstate U.S. Department of Transportation (USDOT) number.

The Federal Motor Carrier Safety Administration (FMCSA) initiated two new entrant training and testing research demonstration projects. This report contains details of the analysis of safety performance results from both the first training curriculum, conducted in 2005–06, and the second conducted in 2010–12. It also contains a discussion of diffusion theory that explains why the results are what they are, and a description of what the blended third-generation curriculum will be.

The third-generation blended curriculum will be more cost-effective, less instructor-intensive, and per the theory and in coordination with the required mandate, dramatically foster adoption of a safety culture among a larger percentage of new entrants. This analysis explains why a blended curriculum that incorporates e-learning and testing is predicted to be superior, and how it could be used to meet the requirements specified by MAP-21.

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SI* (MODERN METRIC) CONVERSION FACTORS

TABLE OF APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
Ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME	1,000 L shall be shown in m^3	
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	mg (or "t")
		TEMPERATURE	Temperature is in exact degrees	
°F	Fahrenheit	5 × (F-32) ÷ 9 or (F-32) ÷ 1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-lamberts	3.426	candela/m^2	cd/m^2
		Force and Pressure or Stress		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

TABLE OF APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
Ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
		TEMPERATURE	Temperature is in exact degrees	
°C	Celsius	1.8C + 32	Fahrenheit	°F
		ILLUMINATION		
Lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-lamberts	fl
		Force & Pressure Or Stress		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003, Section 508-accessible version September 2009.)

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ABBREVIATIONS AND ACRONYMS

ANPRM	Advance Notice of Proposed Rulemaking
ATA	American Trucking Associations
BASIC	Behavioral Analysis and Safety Improvement Category
Beta test	A field test carried out of the training curriculum to identify if there are still any issues that require revision before the curriculum is adopted
CAP	Corrective Action Plan
CD	compact disk
CDL	Commercial Driver's License
CDLIS	Commercial Driver's License Information System
CMV	commercial motor vehicle
CR	compliance review
CSA	Compliance, Safety, Accountability
CSP	Cooperative Safety Plan
CVSA	Commercial Vehicle Safety Alliance
DLN	Driver's License Number
DSL	digital subscriber line
DVD	digital videodisk
e-learning	electronic learning
FDOT	Florida Department of Transportation
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulation
FTO	Field Training Officer
GAO	Government Accountability Office
HM	hazardous materials

HMSP	Hazardous Materials Safety Permit
HOS	hours of service
IST	Institute for Simulation and Training
MAP-21	Moving Ahead for Progress for the 21st Century
MCCO	Motor Carrier Compliance Office
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
MCSIA	Motor Carrier Safety Improvement Act
NAS	New Applicant Screening
NIJ	National Institute of Justice
NPRM	Notice of Proposed Rulemaking
NTC	National Training Center
NTSB	National Transportation Safety Board
OOS	out-of-service
PC	personal computer
PRISM	Performance and Registration Information Systems Management
PSP	Pre-employment Screening Program
RAPTER	Research in Advanced Performance Technology and Educational Readiness
RODS	Record of Duty Status
ROI	return on investment
SA	Safety Audit
SafeStat	Motor Carrier Safety Status Measurement System (program previously used to rank the safety performance of motor carriers)
SBA	Small Business Administration
SCORE	Service Corps of Retired Executives

SMS	Safety Measurement System
TRB	Transportation Research Board
TWGFEX	Technical Working Group for Fire and Explosions
UCF	University of Central Florida
UPS	United Parcel Service
URS	Unified Registration System
USDOT	U.S. Department of Transportation
VMT	vehicle miles traveled

EXECUTIVE SUMMARY

This report provides a recommendation for how the Federal Motor Carrier Safety Administration (FMCSA) can meet the requirements of 49 U.S.C. 31144(b)(1) as amended by the Moving Ahead for Progress for the 21st Century Act (MAP-21) for determining—prior to issuing an interstate U.S. Department of Transportation (USDOT) number—if an applicant new entrant motor carrier is safety fit and meets the National Transportation Safety Board (NTSB) recommendation to ensure that the new entrant adopts and maintains an effective safety assurance program (NTSB Safety Recommendation H-12-31).

Building on lessons learned from two previous generations of primarily instructor-led training curricula, this report provides, in three major parts with subsections:

1. A detailed analysis of the safety performance data resulting from the first- and second-generation training curricula applied in Montana in 2005–06 and 2010–12.
2. A discussion of diffusion theory and associated implications for next steps in the development of a third-generation blended training curriculum.
3. A recommendation for development and testing of a third-generation blended training curriculum that could meet the above-listed requirements.

Process and Policy Framework for New Entrant Applicants

The Motor Carrier Safety Improvement Act (MCSIA) of 1999 recognized that a persistent safety problem exists with new entrant motor carriers. Namely, they are less safe than experienced carriers. Most new entrant motor carrier companies are very small businesses, many of which are not aware of (or do not understand) the applicable regulations and do not have the resources to employ a dedicated safety professional.

It also recognized that because of limited operational exposure, it is not possible for FMCSA's safety monitoring systems to gather enough safety performance information on each of these very small carriers to allow the Agency to manage oversight of their safety performance effectively. To better address these issues, Section 210 of the MCSIA mandated creation of the New Entrant Motor Carrier Program. Those requirements are codified in 49 U.S.C. 31144. FMCSA implemented Section 210(a) of the Act via an interim final rule in 2002 and a final rule in 2008.

Through the required new entrant safety audit (SA), the New Entrant Program has been conducting approximately 32,000–35,000 SAs per year on interstate new entrant motor carriers. However, data obtained from the validation process (or information that could be generated from MCMIS application data) documents the number of initial applicant new entrants is more than twice this.

As a result of the limited contact most of these carriers have with FMCSA's safety monitoring system, the only time many of these carriers see any government official for a somewhat comprehensive overview is under the 2008 new entrant final rule. They receive the mandated, one-time SA (currently mandated to occur within 18 months of issuance of a USDOT number, with that timeframe to be reduced to 12 months by a MAP-21 amendment).

In addition, FMCSA is required to implement the knowledgeability requirement authorized by MCSIA Section 210(b) (now mandated by a MAP-21 amendment). Via the rulemaking process, FMCSA must establish requirements for a proficiency examination and other requirements as necessary to ensure applicant motor carriers understand the applicable safety requirements before they receive an interstate USDOT number.

When implemented, the new rulemaking will create a requirement for the Agency to have a minimum of two mandated points of contact with new entrants: initial contact through training and testing (where it is determined if the applicant qualifies for an interstate USDOT number), followed by a second point of contact during the Safety Review (currently being addressed via SAs). The analysis of training and testing of new entrants that is reported in this document provides various recommendations for how to make the New Entrant Program more effective by incorporating the training and testing and logical conforming changes.

Overview of Part I (A): Findings from the First-generation Curriculum

The 2005–06 first-generation voluntary training demonstration consisted of a half-day of one-on-one training and mentoring for the owner/manager at each carrier's location; a recommendation that the new entrant prepare (as homework) the recordkeeping files required by FMCSA; an offer to receive a review/comments on the adequacy of the prepared recordkeeping files (e.g., a mock audit); and telephonic technical support to aid the new entrant carrier in preparing or correcting the required recordkeeping files.

For the first-generation training demonstration there were three target groups:

- **Homework new entrants.** These new entrants completed the recommended, voluntary, hands-on homework and received a follow-up critique/mock audit. They comprised 52 percent of the Montana trained new entrants, and they were successfully convinced to adopt a safety culture.
- **No-homework new entrants.** While these new entrants completed the half-day of training, they chose not to complete the recommended homework and thus did not receive a follow-up critique/mock audit.
- **Control group.** These new entrants received no intervention.

The safety performance of homework new entrants was statistically significantly better on all measures than that of the control group. For the no-homework new entrants, their crash rate, as measured using the carriers' drivers' crash rate (explained in detail in Appendix F), was substantially better than the control group. Due to a limited amount of data, their lower crash rate was statistically significant only at the 95-percent level, rather than the more conservative 98-percent level used in many other tests for the first-generation training. However, their inspection results were not significantly better than the control group.

The improvement in safety performance for the surviving homework carriers (i.e., those that were still in business at of the end of the analysis) over the control group was still persistent 5 years after the training. This is a strong indicator that such training can successfully foster permanent adoption of a safety culture, which positively influences the carriers' (and drivers') safety performance. It also appears to be positively correlated with business survival. There is even stronger evidence from the second-generation training of the impact on business survival of adopting a safety culture.

Figure 1 provides a summary of results of the analysis of safety performance measures, both as check marks and numbers. The check marks illustrate that the safety performance of the homework new entrants was significantly better than that of the control group new entrants. In fact, the safety performance of the homework new entrants improved so much that it was comparable to the safety performance of the entire population of motor carriers (i.e., the homework new entrants closed the safety performance gap with experienced carriers).

Safety Performance Measure	Homework Carriers' Safety Performance Compared to the Control Group of New Entrants		Homework Carriers' Safety Performance Compared to Experienced Carriers	
	Is Significantly Better	How Much Better (or Worse)	Is Not Significantly Different	How Much Better (or Worse)
Percent of Inspections with Violations	✓	11%	✓	5%
Percent of Inspections with OOS Orders	✓	34%	✓	7%
Percent of Inspections with Driver Violations	✓	23%	✓	(6%)
Percent of Inspections with Driver OOS Orders	✓	54%	✓	(4%)
Percent of Inspections with Vehicle Violations	✓	13%	✓	20%
Percent of Inspections with Vehicle OOS Orders	✓	29%	The performance of homework carriers was significantly better than the overall population of carriers.	17%
Carrier's Drivers' Crash Rate	✓	84%	✓	42%
Projected Safety Audit Results	✓	96%	N/A	N/A

Figure 1. Checklist. Summary of the statistical impact of training.

These empirical results dramatically corroborate (and illustrate) the theory that early, proactive, voluntary training and testing—even using the very simple and brief, voluntary first-generation curriculum—was very effective for more than half of the trained interstate new entrants. Business continuity/survival appears to have been positively impacted, too, as more of the homework carriers continued to operate than the no-homework carriers for the duration of the data analysis extract (until August of 2009).

Overview of Part I (B): Findings from the Second-generation Curriculum

The analysis in Part I (B) compares the safety performance of new entrants who received training under the 2010–12 second-generation, voluntary curriculum with the control group and those who declined the training. The group that attended training but did not complete the homework was too small in the second-generation training to be analyzed meaningfully, presumably because of the improved curriculum. The analysis also compares the safety performance of second-generation trained new entrants with that of the first-generation trained new entrants.

A variety of factors led to a considerably different and more volatile enforcement environment during the 2010–12 second-generation training demonstration. First, FMCSA was majorly focused on implementing the Compliance, Safety, Accountability (CSA) Program, which temporarily diverted resources away from performing SAs. As a result, there was a backlog of SAs. Auditors were then forced to address all of these backlogged SAs as quickly as possible in order to complete them within the required 18-month period. Simultaneously, there was a softening of the initial SA requirements via guidance to reduce the number of failures and resultant required corrective action plans (CAPs) to be reviewed by the Service Center.

These factors (and a number of other factors discussed in Section 4 of Part B) drove different behavior decisions of new entrants that were eligible to participate in the second-generation training. A shift in enforcement focus and a softening of the SA requirements led second-generation new entrants to adopt the attitude that the SA was not something to worry about. This led to a dramatic decrease in participation during the latter part of the training period and eventual near-failure of new entrants to agree to participate in the training. That result demonstrated that a voluntary training and testing program will not achieve the desired MCSIA or MAP-21 result.

Despite the operational issues highlighted above, the second-generation training still had a clear positive impact on trained new entrants' crash performance and business survival. A detailed analysis of the results of the second-generation training can be found in Section 5 of Part B. A few highlights are as follows:

- The homework trained carriers remained in business at a far greater rate than both the control group of new entrant carriers and those that declined the training.
- The homework trained carriers' drivers, even with a few poorly performing outliers, had much lower crash rates than the drivers associated with the control group and those associated with Montana new entrant carriers that declined the training.
- The performance on SAs of trained carriers was much better than the performance of both the control group new entrants and the Montana new entrants that declined the training.

Overview of Part II: Discussion of Diffusion Theory and Other Suggested Improvements

Diffusion theory (discussed in detail in Appendix C) predicts the pattern of success of interventions that are intended to change a group's behaviors or perceptions. In this case, the intervention (new entrant training) is designed to influence the target group (new entrants) to adopt a safety culture in order to operate more safely. Diffusion theory states that there is a progression of increasingly difficult-to-convince subgroups within all groups.

Diffusion theory applies very well to the 2005–06 first-generation training results. The theory accurately predicted that approximately half (in that case, 52 percent) of the trained new entrants would adopt a safety culture. As discussed above, the second-generation training was impacted by a number of external factors that influenced new entrants' behaviors differently than for the first-generation training. As such, diffusion theory correctly predicted that with the additional confusion of competing new ideas being advanced in Montana at the same time, and thus lack of clear communication regarding the value of training, the predicted outcome was that the offer of the second-generation training would be increasingly ignored by the new entrants. As predicted, during the second-generation training, as other things happened in Montana, there was a corresponding decline in the rate for agreeing to attend the training, with a high of 59 percent near the beginning to a low of 8 percent at the conclusion.

Surprisingly, the completion rate for those who did decide to attend the training (which meant preparing the homework and having it critiqued via a mock audit) remained around 85 percent throughout. This may be attributable to the improved curriculum and the inclusion of peer interaction in the learning and sharing process. Those items are retained in the third-generation training.

Diffusion theory, as applied to new entrants, indicates there are several things that can influence willingness to adopt a safety culture. The blended curriculum discussed in Part III of this report will allow FMCSA to reach and more effectively influence the more resistant subgroups of new entrant carriers. However, in order to get the most resistant subgroups of new entrant carriers to participate and engage in the recommended training and testing, the training and testing will need to be mandatory.

Even so, the theory predicts it is likely there will be a residual subgroup of new entrants that is so highly resistant to adopting a safety culture that not even mandatory training and testing will work. Some of those resistant new entrants may be detected via the training and testing and prevented from gaining authority to operate interstate. However, it is likely that enforcement will need to detect the remaining most resistant new entrants and determine whether they should be allowed to continue operating.

Other Suggested Improvements

This report recommends that FMCSA could perform several other data review and screening activities (currently carried out as separate program initiatives) while training and testing applicant new entrants. Namely, FMCSA should use the training and testing as an opportunity to 1) validate an applicant's qualification for the New Entrant Program, verifying data quality and identifying officers, 2) identify suspected reincarnation attempts, and 3) determine whether the new entrant would be operating under the same officers as any other motor carriers (the latter could indicate either a carrier operating as part of a managed enterprise or a reincarnated carrier.)

MAP-21 mandates that the Agency establish safety fitness before issuing a new entrant an interstate USDOT number. To aid in this effort, it is recommended that new entrants be required to meet the SA requirements while completing the training and testing, before being issued an interstate USDOT number. Having made that recommendation, the logical follow-on recommendation is that the existing SA (originally conducted within 18 months after issuance of the USDOT number) should be replaced with an enforcement review of the new entrant to ensure ongoing compliance with the requirements.

This enforcement review should be used as a tool to identify and justify removal of non-compliant new entrants. Such carriers are more likely to be in the most resistant subgroup defined in diffusion theory. Problem small carriers will be hard to identify after the enforcement review based on the very thin roadside inspection safety performance data collected for very small motor carriers.

Overview of Part III: Next Steps for Implementing a Third-generation Curriculum

This section explains how a blend of supervised e-learning technologies with embedded testing, group instructor-facilitated peer discussions, hands-on homework (that involves physical preparation of the required recordkeeping files), and critical evaluation and feedback would more effectively promote adoption of a safety culture and maintenance of an effective safety assurance program by new entrant motor carriers. This should include the applicant demonstrating they understand at least the equivalent of passing the SA, before being given an interstate USDOT number. Some of the benefits of the third-generation blended curriculum are as follows:

- The electronic learning (e-learning) training portion will provide a convenient platform for administering proficiency testing and maintaining records throughout the training.
- The e-learning will be provided from a centralized server(s), making it possible to apply controlled revisions to the curriculum based on lessons learned. Other benefits of the centralized electronic location include:
  - It will eliminate the ability for any third-party training providers to rig tests to pass trainees fraudulently.
  - It will simplify administrative recordkeeping, making it easier to track which new entrants have successfully completed the mandated training and testing.
- The e-learning modules will allow for national standardization of the curriculum, which would be more difficult to achieve with instructor-led classroom training.
- Replacement of classroom instructors with the e-learning software will make it easier to identify and hire individuals who can supervise the e-learning and facilitate the subsequent peer group function.
- It will be easier to achieve a geographically dispersed qualified pool of e-learning providers with the needed supervisors and discussion facilitators, thus making it easier for new entrants located around the country to attend training and testing sessions locally.
- Both the e-learning media and the group discussions will enable more enhanced feedback and reinforcement—tailored for each new entrant—which is predicted to result in greater understanding of the regulations and the importance of safe operations.

- The simulations in the e-learning media will provide active learning experiences, and the homework practice and critique will further enhance understanding and improve knowledge retention.
- The use of supervised e-learning and testing and group discussion settings will critically enable control and documentation of who is taking the training (namely, that it is the owner/manager of the new entrant company who is participating, not a hired consultant or company employee).
- It will also provide a convenient forum for validating whether a motor carrier is qualified to be in the New Entrant Program, whether the data provided on various Agency application forms is accurate, and whether any applicants appear to be attempting reincarnation.
- The follow-up review of the new entrant's required recordkeeping files will provide performance evaluations, indicating whether the new entrants understand the safety regulations and the required management oversight processes.
- Implementation of e-learning modules will significantly reduce labor costs associated with highly-trained instructors who are required for classroom-based learning.

If FMCSA adopts and applies the third-generation curriculum described in this report, the Agency will have met the requirements specified in 49 U.S.C. 31144(b)(1) and MAP-21. It is predicted that the third-generation blended curriculum could not only fulfill the requirement to implement training and proficiency testing for new entrant motor carriers, but it would also result in a very significant increase in the percentage of new entrant motor carrier companies that choose to adopt a safety culture.

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PART I (A): FINDINGS FROM THE FIRST-GENERATION CURRICULUM

1. INTRODUCTION

1.1 FEDERAL REQUIREMENTS

In the mid-1990s, the Federal Highway Administration Office of Motor Carrier Safety completed an analysis that documented that new entrant motor carriers have less-safe operations than experienced motor carriers. Further, it documented that the Agency's safety performance monitoring processes do not obtain enough safety performance data to properly monitor most new entrants' safety performance.[(1)] Based on that information, the Motor Carrier Safety Improvement Act (MCSIA) of 1999, which established the Federal Motor Carrier Safety Administration (FMCSA), in Section 210 amended 49 U.S.C. Section 31144 (Safety fitness of owners and operators) by adding requirements for creation of a New Entrant Program.

The New Entrant Program was implemented by FMCSA with an interim final rule in 2002 and a final rule in 2008. What remains to be implemented are the portions of Section 31144(b)(1), as more specifically addressed by Section 210(b) of MCSIA (as amended by the Moving Ahead for Progress in the 21st Century Act [MAP-21]). It now requires inclusion of a written proficiency examination, as well as other requirements to ensure such applicants understand applicable safety regulations before being issued an interstate USDOT number. Moreover, the National Transportation Safety Board (NTSB) recommended that motor carriers maintain a safety assurance program (see Appendix B).

There are two requirements and one recommendation that guided this research into the effectiveness of training and testing new entrants to foster adoption of a safety culture. First, 49 U.S.C. Section 31144(b)(1) specifies that there must be an initial requirement for determining whether an applicant for an interstate U.S. Department of Transportation (USDOT) number is "safety fit." Second, as part of the rulemaking to establish the initial requirement for safety fitness determination, FMCSA is also required to ensure that the new entrant applicant understands the safety regulations before an interstate USDOT number is issued. Finally, NTSB's recommendation (described above) can be considered a subset of establishing a safety culture in the new entrant, and so it guides this research as well.

These requirements of the New Entrant Program proactively address the fact that FMCSA's safety performance monitoring system does not obtain sufficient operational safety performance data to monitor properly the safety performance of most of these small carriers. Thus, in MAP-21, Congress mandated that FMCSA determine that new entrants fully understand the regulatory requirements before they are granted an interstate USDOT number.

The revised 210(b) mandate is consistent with both the NTSB recommendation that new entrants maintain an effective safety assurance program and with FMCSA's research on how to implement a training and testing program that fosters adoption of a safety culture. Successfully influencing new entrant applicants to adopt a safety culture before issuing them an interstate USDOT number will accomplish all of these goals.

1.2 IMPORTANCE OF A SAFETY CULTURE

The Transportation Research Board's (TRB's) Commercial Truck and Bus Safety Synthesis Report 14, "The Role of Safety Culture in Preventing Commercial Motor Vehicle Crashes," reported that the existence of a safety culture is critical to a motor carrier's safe operations.(2)

The report pointed out that:

> Both empirical and anecdotal evidence … support that "safe" carriers—as defined by numerous metrics including SafeStat scores, safety awards, and industry safety statistics—produce, attract, and retain safe drivers.

Uttal (1983) defined organizational culture and its relationship to safety as follows:(3)

> The norms, attitudes, values, and beliefs of organizations define the culture of an organization and are manifested in the behaviors of its agents (e.g., in motor carriers' managers, dispatchers, mechanics, drivers). For many organizations, safety and loss prevention are the highest concerns.

The Canadian Council of Motor Transport Administrators report entitled "Addressing Human Factors in the Motor Carrier Industry in Canada" said the following regarding the impact of motor carrier safety culture on safety performance, including crashes:

> . . . implementation of a strong positive safety culture within the industry, or within individual carriers, provides a scientifically sound approach to problems that were empirically identified as the main causes for CMV crashes (fatigue, distraction, risky driving). Thus, implementing a strong positive safety culture to prevent driver errors is one of the key recommendations of this task force.(4)

Safety Culture in Organizations

Every organization has a culture—a set of written and unwritten rules and assumptions that determine group behaviors and attitudes.(5)

A hypothesis that grows from this is that the ongoing operational safety behavior of drivers is predominantly shaped by their motor carrier's safety culture. Thus, a motor carrier's safety culture should manifest itself in safety performance statistics relating to all aspects of operations, including drivers' safety performance. The importance of driver safety behavior is illustrated by data that appears in the "Large Truck Crash Causation Study." Namely, when the large truck was determined to be the cause of the critical event that led to the crash, the driver was assigned the critical reason for the crash in 87 percent of those events.

This leads to a corollary hypothesis: namely, efforts that succeed in fostering a safety culture in motor carriers may be far more effective in shaping the ongoing operational driver safety behavior than entry-level driver training efforts aimed directly at drivers' knowledge and skills.

While entry-level driver training is critical for the driver's initial basic skills, it is the employing motor carrier's culture which demands that employed drivers operate according to the company's established values.

The Small Carrier/Safety Culture Conundrum

> The majority of the … trucking companies in the United States are very small operations that do not have the ability to maintain a safety department, or even a person dedicated to safety. While it may be true that a positive safety culture can lead to improved safety performance results, what are the implications of this, if any, for small carriers? Can a safety culture be developed among employees of a small carrier, particularly those carriers not large enough to have a safety department or safety professionals on staff? (6)

There is a clear theory that if one could successfully foster adoption of a safety culture in small motor carriers, it would improve safety performance and reduce crashes. However, motor carrier safety literature does not provide any clear direction on how to do this for very small motor carriers. This is a significant issue because very small motor carriers make up the very large majority of motor carriers.

The following questions are posed to provide guidance on how to approach this issue with very small motor carriers (i.e., those too small to have a safety department or safety professional on staff):

- Who develops, defines, and communicates shared values regarding safety in a work environment?
  - In very small motor carriers, this is going to be the top management responsible for that motor carrier, which often is likely a single person.
- What are the internal policies and procedures (i.e., beliefs) that create a culture of safety?
  - The data analyzed below indicate that even the very simple, first-generation 2005–06 training curriculum successfully convinced slightly more than half of those very small motor carriers to adopt a safety culture, which dramatically improved safety performance.
- How do the values and beliefs regarding safety interact with other organizational values and beliefs?
  - Empirical information indicates that they interact positively with other organizational values and beliefs. An indirect measure of this is a substantial improvement in driver retention for the new entrants that adopted a safety culture.
- How does a safety culture become standard practice throughout a company?
  - The owner/manager of the new entrant motor carrier needs to be convinced of the importance of safe operations and must set the expectations. This is why training new entrant management can be so powerful.

1.3 MEASURING WHETHER A SAFETY CULTURE CAN BE FOSTERED

This section analyzes the hypothesis that properly constructed, proactive, early training and testing of new entrants' management significantly persuades them to adopt a long-term safety culture. That, in turn, positively influences all safety aspects of their operations, including driving behavior.

Both the first- and second-generation curricula applied in Montana were completely voluntary, as there was no FMCSA requirement for new entrants to engage in training and testing at that time.

Quantifiable measures for evaluating the effectiveness of this hypothesis include:

- Passing the safety audit (SA) and providing detailed answers to all of the questions.
- Performance in roadside inspections.
- On-the-road driving performance.
  - For example, commercial driver's license (CDL) convictions and suspensions and/or driving violations reported by enforcement officers to the Motor Carrier Management Information System (MCMIS).
- Staying in business.
- Crashes.

1.4 AVAILABLE TRAINING DATA

Shortly after issuance of the New Entrant Interim Final Rule in 2002, internal discussions began on what the final rule might look like. Those discussions included the idea that there would be a higher threshold for passing the SA. Those new entrants that did not pass would have to prepare and submit a Corrective Action Plan (CAP), which was proposed to be processed by FMCSA's Division offices in each State (after the States stated in the docket for the original notice of proposed rulemaking (NPRM) that they would not adopt this function). Ultimately, it was decided to make it a Service Center function.

Using new entrant grant funds, FMCSA sponsored a simple, voluntary first-generation new entrant training effort in Montana in 2005–06. That training was undertaken in an effort to see if it could prevent the expected rise in the failure rate of new entrant SAs, and to improve safety performance. In turn, the reduction in the failure rate would also reduce the anticipated workload on Division staff resources.

The first-generation simple training curriculum consisted of:

- A half-day of one-on-one training and mentoring for the owner/manager at each carrier's location.

- A recommendation that the new entrant prepare (as homework) the recordkeeping files required by FMCSA.
- An offer to review and comment on the adequacy of the prepared recordkeeping files.
- Telephonic technical support to aid the new entrant carrier in preparing or correcting the required recordkeeping files.

At the end of fiscal year 2006, FMCSA made a policy determination that new entrant grant funds should only be used to conduct the SA and not to support training new entrants. As a result, funds were no longer available to support the next option year of the training, and the contract was terminated as of September 30, 2006.

During the period that the curriculum research demonstration was operational, training was completed for 221 new entrant motor carriers in Montana. These trained new entrants constitute the intervention population for this analysis.

The remaining sections of Part I (A) provide analysis of the first-generation curriculum by utilizing data from the contractor that identified each of the trained new entrants (and indicated whether they completed the recommended homework). A control group that did not receive training was selected to compare the trained new entrants' safety performance. For the first-generation curriculum, it was not possible to determine the exact number of valid interstate new entrants that declined the training; however, researchers did maintain this information during the second-generation training.

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2. DATA ANALYSIS METHODOLOGY USED FOR THE FIRST-GENERATION NEW ENTRANT CURRICULUM

Due to considerable differences in data quality over time, especially for crashes, it was decided that a before-and-after analysis approach could not be used. Instead, it was decided that data would be compared in the same time frame between the intervention/trained group in Montana and a representative control group.

Thus, safety performance data for the 2005–06 trained new entrants were compared to the safety performance data for a carefully selected, representative control group of similar new entrants from other States that did not receive the first-generation training. This analysis documents that the 2005–06 training successfully convinced slightly more than half of the trained new entrants to adopt a safety culture voluntarily. This is evident by the observed improvement in vehicle and driver safety performance for this group of new entrants.

Initial analysis quickly showed that the pattern of roadside inspection results differs substantially among States. Analysis of differences in data found two distinct types of variations among States: seasonal and structural.

Seasonal variations are regularly cyclical. In some cases, effects are reversed when comparing northern and southern States. For example, Florida conducts a higher percentage of Level 1 inspections during the winter months, while Montana conducts a higher percentage of these inspections in the summer months. Because the data span several years, and because control group new entrants came from States near Montana, such seasonal differences are negligible.

However, within control States and Montana, there were substantial systemic structural differences in program enforcement emphases. These require statistical adjustment to make the State-by-State safety performance results more comparable for statistical analysis. Specifically, without an appropriate adjustment, Montana-based new entrants would appear to have better safety performance than control group new entrants on a number of vehicle measures, but would appear to have worse safety performance on driver measures. These differences are based on systematic structural differences in State enforcement program patterns, not on any real difference in carrier safety performance.

This required development of a systematic method for adjusting individual State safety performance measures to make them statistically more comparable. An initial less detailed methodology was used for the first-generation analysis, and a more detailed and nationally applicable methodology was used for the second-generation analysis. This more detailed methodology used for the second-generation analysis was cross checked against the first-generation analysis to ensure that the methodologies were comparable. Details on development of the required statistical adjustments are described in Appendix E.

2.1 GENERAL APPROACH

Data to support this analysis were originally extracted from MCMIS in August 2009. Thus, from completion of the training in September 2006, several years of safety performance data were available. This was both for new entrants that received the new entrant first-generation training and for the corresponding new entrants selected to be part of the control group.

The goal of this analysis was to determine if the 2005–06 simple, proactive first-generation training successfully fostered adoption of a safety culture in trained new entrants, and if that adoption led to better safety performance. The effectiveness of the training in fostering a safety culture was measured by determining if there were differences in the safety performance of trained versus control group new entrants.

An important issue that had to be addressed during the analysis was the significant limitation regarding the safety performance data collected for individual small motor carriers. Namely, as pointed out above, the New Entrant Program was created because there is very little observational safety performance data available for individual small motor carriers. This remains a common issue still encountered by FMCSA's Safety Measurement System (SMS) software under the Compliance, Safety, Accountability (CSA) Program.

The solution used to make this analysis possible was to pool the data available, and to group new entrants into three groups: Montana homework, Montana no-homework, and "other States" control groups. This approach yielded sufficient data for evaluating each group's safety performance on the wide range of safety performance measures available. The researchers looked at statistical differences in those measures between the two Montana trained subgroups (homework and no-homework) and the control group.

For each identified measure, the results of trained new entrants were compared to results of the selected representative control group of similar new entrants. Homework new entrants accepted the recommendation to complete the recordkeeping files required by the Federal Motor Carrier Safety Regulations (FMCSRs) and provided them for review and critique. Their decision to complete the recommended homework is interpreted as an implicit indicator that those new entrants took FMCSA safety requirements seriously, and that they likely adopted a safety culture. Their significantly better safety performance measures corroborate this interpretation.

No-homework new entrants did not turn in the completed recordkeeping files required by the FMCSRs for review and critique. The implication is that they purposely chose not to complete the recommended homework, and there is antidotal evidence to support this implication. Not completing the homework indicates that those new entrants did not take the FMCSA safety requirements seriously, and that they likely did not adopt a safety culture. Their limited improvement in safety performance inspection measures, and less significant improvement in crash rates, further corroborates this interpretation.

Because of the relatively small number of trained new entrants and the impact that small sample sizes have on statistical significance, the analysts expected difficulty in demonstrating that differences in safety performance were statistically significant. Furthermore, the trained new entrants subdivided themselves into two smaller intervention groups (homework and no-homework new entrants), compounding difficulty in determination of statistical significance. That means the difference between performance of the two target subgroups and performance of the control group would have to be very greater in order to be statistically significant.

Thus, the statistically-significant findings for homework new entrants were surprising, and the near-statistical significance for no-homework new entrants was even more astonishing. This indicated the training and testing had a very significant impact in order to be statistically detectable.

2.2 SAFETY PERFORMANCE MEASURES

Three types of safety performance measures were identified:

- Direct measures of actual safety performance (i.e., crashes).
- Indirect measures of safety performance (e.g., safety violations discovered during roadside inspections, out-of-service [OOS] orders, and Motor Carrier Safety Assistance Program [MCSAP] traffic enforcement violations).
- Measures that are proxies for safety performance, such as SAs and compliance reviews (CRs).

Direct Measures

Crashes are the direct measure of safety performance. All other safety measures are indicators used to build a predictor for future crash risk based on past behaviors and safety performance.

Two different measurement approaches were applied for this crash performance analysis: the carrier-centric crashes per carrier's reported power units, and the driver-centric carriers' drivers' crash rate.

MCMIS is the authoritative source for all "reportable" commercial motor vehicle (CMV) crashes. However, it is not enough to count crashes for a carrier—a large carrier could have many crashes and still be considered a very safe carrier. In order to create a crash rate, a measure of exposure is required. The measure of exposure is the denominator in the rate calculation, and the number of crashes is the numerator.

The two measures of exposure used for this study are reported power units and the number of drivers associated with that carrier determined by safety performance reports.

Details about these two exposure measures, and how the associated measures are calculated, are explained and analyzed in Appendix F.

Indirect Measures

There are a number of indirect measures of carrier safety performance. These are measures of safety performance events that are generally accepted as being associated with crash risk. This report presents results for the following measures calculated from data available from MCMIS:

- Percent of carriers' inspections that result in violations are grouped into:
  - Driver violations.
  - Vehicle violations.

- Percent of carriers’ inspections that result in OOS orders are similarly grouped into:
  - Driver OOS orders,
  - Vehicle OOS orders.
- Carriers’ drivers’ inspection violation measure.

Proxies for Safety Performance

Two measures were used as proxies for risk of poor safety performance: SA results and CR results.

Specifically, for new entrant SA results, data were compared to the new standards for passing the SA, based on the final rule issued in December 2008. Results identified whether the new entrant would have failed the SA based on the new standards. This is an important measure to FMCSA, as failing the SA will result in cost and effort for both the new entrant and FMCSA:

- New entrants that fail the SA must develop and file a CAP.
- FMCSA service centers manage the program and evaluate whether the CAPs are acceptable.

SMS Scores

Carrier safety performance, as measured by FMCSA’s SMS evaluation tool, was also applied. The SMS scores were calculated for all new entrants in the trained group and the control group and provided to the researchers. Individual results were then grouped (by homework, no-homework, and control) to identify patterns (by group) based on the individual carriers’ results.

2.3 COMMONLY USED TERMS

Definition of Target Group

The term “target group” is used in a number of tables in this report. The term “target group” is used in the text of a row to reference a measure on what members are included in the group identified in the appropriate column.

Table 1 provides examples of how the restrictions are applied to define target groups.

Table 1. Example of target groups.

Row Number	Measure	Control Group	Montana Homework Carriers	Montana No-homework Carriers
1	Drivers Who Also Had Validly-formatted Driver's License Number (DLN)	12,715	278	153
2	Inspections for Target Carriers (Where Driver Had Validly-formatted DLN)	34,928	916	435
3	Total Violations in Inspections for Target Carriers (Where Driver Had Validly-formatted DLN)	81,854	1,365	956

Row 2 is labeled "Inspections for Target Carriers (Where Driver Had Validly-formatted Driver's License Number (DLN)." This means:

- There were 34,928 inspections for the 12,715 drivers for control group new entrants in Row 1 (where the driver had a validly-formatted DLN).
- There were 916 inspections for the 278 Montana homework new entrant drivers in Row 1 (where the driver had a validly-formatted DLN).
- There were 435 inspections for the 153 no-homework new entrant drivers in Row 1 (where the driver had a validly-formatted DLN).

Similarly, Row 3 is labeled "Total Violations in Inspections for Target Carriers (Where Driver Had Validly-formatted DLN)." This is interpreted as:

- There were 81,854 inspection violations in the 34,928 inspections on control group new entrants in Row 2.
- There were 1,365 inspection violations in the 916 inspections on Montana homework new entrants in Row 2.
- There were 956 inspection violations in the 435 inspections on no-homework new entrants in Row 2.

Statistical Significance

This report takes the standard statistician's risk-averse position. Specifically it is better to not assert significance of the training unless the probability of being correct is very high, even if it risks missing that there might be a real difference. This position avoids incorrectly asserting that there is a difference caused by training when the difference might be because of randomness. The high bar of statistical significance means differences so determined are extremely unlikely to have occurred by statistical chance.

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3. RESULTS FROM APPLICATION OF THE FIRST-GENERATION CURRICULUM

3.1 INSPECTIONS

This section presents various inspection measures comparing Montana homework and no-homework new entrants with control group new entrants for inspections from January 1, 2006, to the end of the data extraction period in August 2009. Table 2 provides some basic inspection statistics for each target group. The number of inspections per group is larger than the number of drivers shown in Table 1 above because drivers received more than one inspection in the 4.5 years of data collection.

Table 2. Inspection statistics for each target group.

Group	Number of Carriers	Number of Inspections	Average Number of Inspections Per Carrier	Percentage/Number of Subgroup That Received Inspections	Average Number of Inspections per Inspected Carriers
Montana Homework	117	1,140	9.7	91% (107 out of 117)	10.6
Montana No-Homework	104	665	6.4	78% (81 out of 104)	8.2
Control Group	6,434	47,775	7.4	75% (4,806 out of 6,434)	9.9

The number of total inspections per inspected carrier is dramatically higher for the first-generation training. Some of this is because there were about 4.5 years to accumulate safety performance data, whereas in the second-generation there were about 4.17 years. However, there is a larger decrease in the number of homework new entrant inspections performed by Montana during the second-generation training than would be expected by this slightly shortened data collection time. It is also not consistent with the total number of inspections performed by the State, which are fairly consistent with previous years' inspections. A possible reason might be that the homework new entrants were operating disproportionately in the Bakken oil fields area, where the inspection station was shut down due to the congestion.

The average number of inspections per inspected new entrant for the control group lies between the average numbers of inspections for homework and no-homework new entrants (9.9), which indicates that the criteria used for selection of the control group achieved a representative control group.

The difference between the number of inspections per inspected homework new entrant and the control group is smaller than the difference between the average number of inspections per inspected no-homework new entrant and the control group.

Although the difference in number of inspections per inspected carrier is greater for the homework group than the control group and less for the no-homework group, the differences are not statistically significant because the numbers in the homework and no-homework groups are small.

The director of the 2005–06 training believed the substantially lower number of inspections for no-homework new entrants might indicate a deliberate behavioral pattern. Namely, a number of these new entrants realized they did not fully understand the FMCSRs, and thus were not sure if they were in compliance with them. Therefore, this subgroup may have chosen to operate out of sight of the inspectors as much as possible by using State roads around the roadside inspection locations that were primarily located at interstate weigh stations. The reverse could be said for the homework new entrants, who had the highest inspection rate. Further supporting this hypothesis is that although the homework carriers received more inspections, their safety performance on those inspections is statistically far better than the safety performance for the less inspected no-homework new entrants.

An additional possible reason for the greater number of inspections received by homework versus no-homework new entrants is that in the initial MCS-150 filing (application for a USDOT number) with FMCSA, the homework new entrants showed an average of 1.84 power units per new entrant, whereas the control group new entrants showed an average of 1.66 power units per new entrant. This small difference in exposure to receiving inspections might also be reflected in the average number of inspections per new entrant.

3.1.1 Implications for Survival

One lesson learned from the 2005–06 training was that many of the new entrants did not appear to have much business management knowledge, which can lead to cutting corners on safety when funds are limited. That lesson learned led to the addition of basic business training, provided by the Service Corps of Retired Executives (SCORE), in the 2010–12 research demonstration. In the future, such training might be offered by the labor offices maintained by all States or (perhaps more appropriately) incorporated in the third-generation blended curriculum.

An indication of differing business survival is shown by the attrition of safety performance contacts made with members of the two subgroups of new entrants (illustrated in Figure 2). The normal business failure pattern is that a large number of new small businesses go out of business very quickly. An indirect measure of this is the percentage of inspection contacts that continue to be made with both subgroups of the Montana trained carriers. As expected, this percentage steadily declines from the high point at the time training ended in September 2006 to the end of the original data extract for this analysis in August 2009.

By the fourth year, the homework new entrants had maintained a higher percentage of inspection contacts than the no-homework new entrants (i.e., more power units for homework carriers were likely remaining in business and operating under their USDOT numbers and were not leased to another company). This provides an indirect measure of the value that an applied safety culture has on business survival for new entrants.

A hypothesis for why new entrants might be going out of business is that most new entrant carriers likely carry only the minimum required liability insurance. Thus, if they are involved in a crash, they may not have the resources to repair or replace the truck. Analysis of this hypothesis did not find any meaningful relationship between crashes and business failure. Details of that analysis are presented in Appendix G.

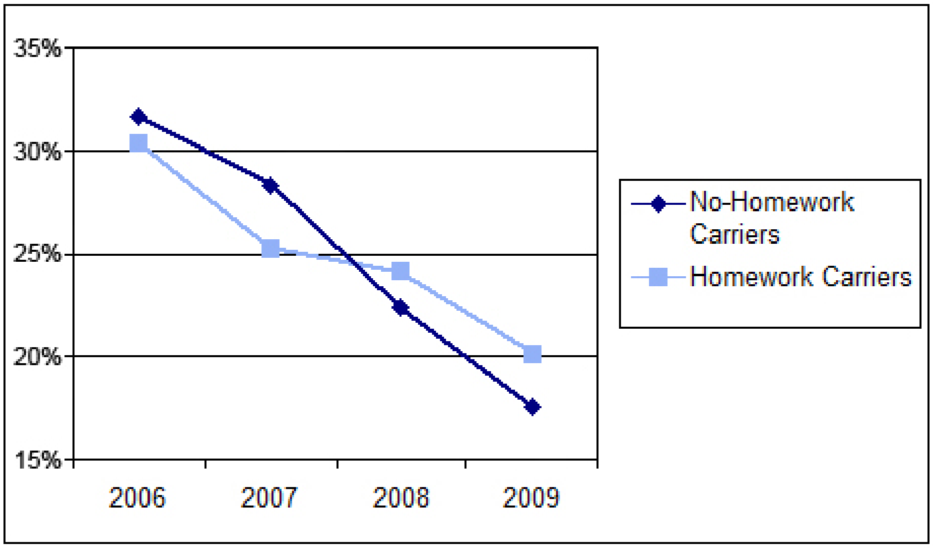

Figure 2. Line chart. Implied survival rate indicated by roadside inspection contacts.

Section 5.5 presents a detailed tracking of the 2010–12 new entrants that declined to take the training and a more direct measure of which new entrants went out of business.

Another way to look at the differential survival of the homework and no-homework carriers is by both the number who remained in business and their growth in number of power units of the respective groups (see Table 3).

Table 3. Comparative business success, based on company size (number of power units), between the homework and the no-homework carriers in the first generation of training.

Measure	Homework Carriers	No-homework Carriers
First-generation Number of Carriers	117	104
Power Units in Original Census	190	191
Average Number of Power Units for Original New Entrants	1.62	1.84
Carriers Remaining in the August 2013 Carrier Table	80	71
Original Number of Power Units for the Remaining Carriers	154	139
Average Original Number of Power Units for Remaining Carriers	1.92	1.96
Power Units in the August 2013 Carrier Table	251	175
Average Number of Power Units per Remaining Carrier	3.14	2.64

This shows that in both the homework and no-homework groups, 68 percent of the first-generation carriers were still in business as of the August 2013 MCMIS data snapshot. However, by August of 2013 there was a substantial reversal in the average number of power units per new entrant, with the homework new entrants having grown by 94 percent, versus the no-homework new entrants having grown by only 43 percent. Assuming that trend happened throughout the period, then the greater drop in the number of inspection contacts for no-homework carriers in the first-generation analysis (see Figure 2) indicates that the homework carriers likely had greater exposure with their growing number of power units.

Overall, the original no-homework carriers had 1.84 power units per carrier, while the homework carriers had 1.62. This supports the observation that the original homework carriers were slightly smaller than the no-homework carriers.

The no-homework carriers that remained in business had 2.46 power units per carrier in August of 2013. These same 71 carriers had initially reported an average of 1.96 power units per carrier.

In comparison, the remaining 80 homework carriers had 3.14 power units per carrier in August of 2013. These same 80 carriers had initially reported an average of 1.92 power units per carrier. It appears that the homework carriers that remained in business were more successful in growing their business than were the no-homework carriers that remained in business.

3.1.2 Results on Inspection Measures

A comparison of States for inspections of all motor carriers reveals the differences in both number of violations and number of OOS orders from those violations. Results from this comparison indicate significant differences in enforcement focus from State to State. For purposes of this analysis, such State differences in program emphasis do not reflect a difference in safety performance of new entrant carriers, but a difference in which safety performance metric each of the States is emphasizing. Therefore, it was necessary to make appropriate statistical adjustments to remove any bias for enforcement program differences, leaving the impact attributable to training.

Table 4 presents results of the analysis for various inspection measures. This table compares results for Montana trained new entrants (both homework and no-homework) to results for the control group. This table uses adjustment factors (as explained above) to isolate safety performance differences among these three target groups from differences in State program emphasis. For a detailed explanation of these adjustment factors and how they were calculated, refer to Appendix E. Note that a more sophisticated generalized adjustment methodology was developed for the second-generation analysis.

Table 4. Safety Performance inspection measures and significance level of Montana measures.

Measure	Adjustment Factors*	Control Group Actual Results	Adjusted Control Group Expected Value*	Montana Homework Carriers (Significance Level)	Montana No-homework Carriers (Significance Level)
Percent of Inspections With Violations	6.82%	73.25%	66.43%	59.65% (99.9)	70.38%
Percent of Inspections With OOS Orders	1.48%	25.99%	24.51%	18.33% (99.9)	24.89%
Percent of Inspections With Driver Violations	0.97%	45.29%	44.32%	36.14% (99.9)	41.07%
Percent of Inspections With Driver OOS Orders	-1.03%	10.75%	11.78%	7.63% (99.9)	8.09% (99)
Percent of Inspections With Vehicle Violations	8.74%	48.13%	39.39%	35.00% (99)	45.50%
Percent of Inspections With Vehicle OOS Orders	2.66%	17.48%	14.83%	11.49% (99.9)	18.47%

*Appropriate statistical adjustments were made to remove any bias for State-based enforcement program differences, leaving the safety performance impact attributable to training.

3.1.2.1 Performance of Homework New Entrants

For all measures of safety performance except “Percent of Inspections with Vehicle Violations,” the difference between Montana homework new entrants and the adjusted expected value for control group new entrants was significant at the extremely rigorous 99.9-percent confidence level. Even for “Percent of Inspections with Vehicle Violations,” the difference was still significant at the highly rigorous 99-percent level. This validates the high effectiveness of the first-generation training and testing curriculum for the homework group.

extends the analysis to the control group by showing results comparing inspections for Montana homework new entrants to all inspections for all motor carriers, nationwide. Inspection safety performance measures for Montana homework new entrants were so improved that, from a safety performance perspective, the homework new entrants were statistically indistinguishable from the entire population of motor carriers.

The importance of this improvement in safety performance is how it relates to the Congressional motives for creating the New Entrant Program. The program was created to address the fact that the safety performance of new entrants is substantially worse than nationwide performance of the “experienced” motor carrier community. So it is important to evaluate how the safety performance of homework new entrants compares to that of “experienced” motor carriers.

Note: The entire population is used in this analysis as a representative or proxy for experienced carriers. This is because for inspections conducted in 2008, more than 90 percent of inspected carriers had more than 2 years of experience, and more than 95 percent of inspected carriers had more than a year of experience.

On the measure "Percent of Inspections with Vehicle Violations," the homework carriers' performance was statistically significantly better than this proxy for experienced carriers, but at the less rigorous 95-percent level. On the rest of the measures, the differences in safety performance were narrowed to the point that they were either slightly better or only slightly worse than for experienced carriers, but were not statistically significantly different.

- On the two measures that are program emphasis areas in Montana—"Percent of Inspections with Driver Violations" and "Percent of Inspections with Driver OOS Orders"—performance measures for Montana homework new entrants were so improved that they were only slightly worse than the performance of the overall population of carriers.

- On four measures—"Percent of Inspections with Violations," "Percent of Inspections with OOS Orders," "Percent of Inspections with Vehicle Violations," and "Percent of Inspections with Vehicle OOS Orders"—the safety performance measures for Montana homework new entrants were actually better than the adjusted overall national average.

Table 5. Safety performance inspection measures and significance level of Montana measures.

Measure	Adjustment Factor	Results for All Inspections, All Carriers	Adjusted Expected Value	Results for Montana Homework Carriers
Percent of Inspections With Violations	6.82%	69.32%	62.50%	59.65%
Percent of Inspections With OOS Orders	1.48%	21.02%	19.54%	18.33%
Percent of Inspections With Driver Violations	0.97%	34.92%	33.95%	36.14%
Percent of Inspections With Driver OOS Orders	-1.03%	6.31%	7.34%	7.63%
Percent of Inspections With Vehicle Violations	8.74%	50.84%	42.10%	35.00% (95%)
Percent of Inspections With Vehicle OOS Orders	2.66%	16.16%	13.50%	11.49%

Thus, it can be concluded that application of the 2005–06 first-generation training curriculum resulted in safety performance improvement so great that it closed the gap between homework new entrants' performance and the overall performance of all motor carriers.

3.1.2.2 Performance of No-homework New Entrants

Safety performance inspection measures of no-homework new entrants were generally comparable to those of the control group of new entrants. Interestingly, the no-homework new entrants performed better than the control group on driver measures, a Montana emphasis area, but not as well on vehicle measures. Nonetheless, the small differences in performance, coupled with the very small sample of no-homework new entrants, generally did not allow the assertion that the differences on individual measures were statistically significant.

However, on the measure of Driver OOS, the no-homework carriers performed significantly better than the control group. Other work has documented a substantial correlation between this inspection safety performance measure and crashes. Thus, this is consistent with the finding that the no-homework carriers had a lower crash rate than the control new entrants.

3.1.3 Carriers' Drivers' Inspection Violation Measure

The "Carriers' Drivers' Inspection Violation" measure uses the same concept for analysis as the "Carriers' Drivers' Crash Rate," which is described in detail in Appendix E. Both "Carriers' Drivers" measures differ somewhat from measures in common use and are quite valuable.

First, this analysis addresses the rate of violations per inspection, as well as the percent of inspections that resulted in violations. In general, when there are a larger number of violations per inspection, it is an indicator of the inspector's concern about the safety fitness of the truck and/or driver.

Second, this measure gives an indicator of the number of driver violations that occur when the driver is working for a particular target group, versus the number of driver violations that occur when the driver is working for any motor carrier outside the target group. Knowledge of the number of violations that occur while the driver is employed by the target group, along with the level of those violations, is especially valuable. This is because, when considered together, these measures allow us to determine whether the drivers tend to stay with that target group, whether there is a difference in driver behavior when the driver is working for the target new entrant group as opposed to any non-target carriers, and overall performance of the target group. These provide very clear measures of the influence of the new entrant carrier's safety culture on the behavior of its drivers.

In order to assure that comparable data were used, and because of issues with data quality and rates changing over time for drivers in inspections, the data in Table 6 include only inspections from January 1, 2006 through the end of the original data extract period in August 2009. Furthermore, because the analysis concerns drivers, these counts only include inspections where there is a driver identified and the DLN is validly formatted. This is to enable the future planned analysis of Commercial Driver's License Information System (CDLIS) data for the drivers.

Table 6: Driver and carriers' drivers' inspection measures.

Measure	Control Group	Montana Homework Carriers	Montana No-homework Carriers
Drivers Who Had Validly-formatted DLN	12,715	278	153
Inspections for Target Carriers	34,928	916	435
Total Violations in Inspections for Target Carriers	81,854	1,365	956
Inspections With Violations for Target Carriers	25,552	548	303
Total Carrier's Driver Inspections (Regardless of Carrier)	59,418	1,305	649
Total Violations in All Carriers' Drivers' Inspections	135,094	2,068	1,232
Inspections With Violations for All Carriers' Drivers' Inspections	43,132	800	430
Target Group Percentage of Inspections With Violations	73%	60%	70%
Target Group Violations Per Inspection	2.34	1.49	2.20
Overall Percent of Inspections With Violations (Carriers' Drivers' Inspections With Violations Rate)	73%	61%	66%
Overall Violations Per Inspection (Carriers' Drivers' Violations Per Inspection Rate)	2.27	1.58	1.90
Percent of Inspections for Target Group	59%	70%	67%

This table offers the following conclusions:

- The relative rank of inspection safety performance for each target group on each measure is the same as with the raw measures above that do not consider exposure. The Montana homework new entrants had the best results, the control group new entrants had the worst results, and the Montana no-homework new entrants ranked somewhere in between.
- Drivers associated with the control group new entrants had virtually the same percentage of inspections that resulted in violations when driving for control group new entrants as they did when driving for other non-control group carriers. Specifically, 73 percent of their inspections resulted in at least one violation.
- Drivers for control group new entrants received more violations per inspection (2.34 violations per inspection) when driving for the control group new entrants than they did for inspections received when driving for other carriers (2.17 violations per inspection). It is quite possible that some of the other carriers they drove for over the next 3.5 years were more experienced and/or larger and thus had a safety department or a safety professional on staff. The fact that these drivers had more violations when driving for control group new entrants than when driving for any other carriers is consistent with the theory that new entrants have less of a safety culture than more experienced carriers (i.e., the lack of a safety culture contributes to higher violation rates).
- Drivers associated with the Montana no-homework new entrant carriers had both a substantially better safety performance when driving for any carriers other than the no-homework new entrants (59 percent when not driving for no-homework new entrants) and a much lower average number of violations per inspection (1.29). Again, it is possible that some of the other carriers that the no-homework drivers drove for over the

next 3.5 years were more experienced and/or larger and thus had a safety department or a safety professional on staff.

- One possible explanation revealed by the second-generation 2010–12 research demonstration curriculum is that some motor carriers contracting with new entrants are using a scheme to deliberately distort the carrier inspection results.
  - The new entrant is instructed that an inspection should be attributed to the contracting motor carrier's USDOT number if there are no violations. If the inspection results in violations, the contracted new entrant is instructed to attribute the inspection to its own USDOT number.
  - If this practice is more prevalent among the no-homework new entrants, it would contribute to why no-homework new entrant safety performance statistics are so much worse than homework new entrants, and why the performance of the no-homework new entrant's drivers is so much better in inspections for any other carriers not associated with the no-homework new entrants.
- The reverse is true for drivers associated with homework new entrants (i.e., they had better safety performance measures when driving for homework new entrants).
  - These drivers had the lowest violations of any of the three groups when driving for homework new entrants (on 60 percent of their inspections) and higher violations when driving for any carriers other than the homework new entrants (on 65 percent of their inspections).
  - When driving for the homework new entrants, these drivers averaged 1.49 violations per inspection. When driving for any carriers other than the homework new entrants, they averaged 1.81 violations per inspection. Overall, these drivers had 1.59 violations per inspection.
- This supports the hypothesis that the 2005–06 training affected the homework new entrants' safety culture, and the safety culture affected their drivers' behavior when those drivers were working for the homework new entrants. It also indicates that the safety culture of the homework new entrants is more effective than the safety departments of other carriers that the drivers went to work for outside the target group.

Note: Because of differences in State enforcement patterns, it is not accurate to directly compare violation rates of control group new entrants' drivers with violation rates of trained new entrants' drivers. In fact, consider the difference between:

- The "Drivers' Violation Rate" for control group new entrants when drivers were driving for any carrier other than the control group new entrants (72 percent).
- The "Drivers' Violation Rate" for the homework new entrants when drivers were driving for any carrier other than the homework new entrants (65 percent).

The difference in these two rates is the same as the adjustment factor between Montana and the control group for inspections with violations (7 percent). Based on this, it appears as though the inspection safety performance behavior of these two groups of drivers, when driving for any carrier other than the target new entrants, is indistinguishable.

However:

- When control group drivers were driving for control group new entrant carriers rather than any other carrier, these drivers had no real difference in the percent of inspections that resulted in violations, and a difference of only 0.17 more violations per inspection.
- When homework carriers' drivers were driving for homework new entrants rather than any other carrier, these drivers had 5 percent fewer inspections resulting in violations and 0.32 fewer violations per inspection than homework drivers driving for any carriers other than the homework new entrants.

These patterns further strongly suggest that even the first-generation training curriculum for Montana new entrants was effective in fostering adoption of a safety culture by the homework carriers, and the impact of the safety culture shows in the driver's safety performance, as is evident from inspection measures.

3.2 CRASH RESULTS

While the inspection violation analysis above is interesting, inspection violations are an indirect measure. The critical direct measure is in whether crashes are reduced.

The researchers analyzed crashes using two methods of exposure: carrier-centric and driver-centric. Section 3.2.1 uses the traditional carrier-centric crash rate per number of carriers' power units. Section 3.2.2 uses the driver-centric crash rate per carriers' drivers.

3.2.1 Crashes per Power Unit

The start date of January 1, 2006 was used for including crash data. Overall, the calculated carrier-centric crash rate for all Montana trained new entrants over the period from 2006 to the end of data extraction was 6.01 crashes per 100 reported power units (see Table 7). For this carrier-centric accumulation of crashes, because the number of trained carriers was so small, there was not enough crash data to distinguish between the homework new entrants and the no-homework new entrants. The crash rate per power unit for the control group of new entrants was 9.93 crashes per hundred power units (see Table 8).

The differences in crash rates between the Montana trained and control groups strongly suggest that training improved the crash rate of Montana trained new entrants. The difference is statistically significant at the 95-percent level—a real and substantial difference for this measure.

Table 7 shows crashes stratified by count of power units for all Montana trained new entrants. This table is based on crashes for new entrants from January 1, 2006 to the data cutoff in late summer 2009 (not crashes per year). For carriers that reported no power units, the researchers assumed one.

Table 7. Crashes per power unit for all Montana trained new entrants.

Group	All Montana Trained Carriers	Reported Power Units	Crashes	Crashes Per Hundred Power Units	Average of All Crashes Per Hundred Power Units
No Reported Power Units*	2	2	0	0.00	0.00
1 Reported Power Unit	158	158	17	10.76	10.63
2–4 Reported Power Units	47	115	4	3.48	7.64
5–9 Power Units	11	67	1	1.49	6.43
10–14 Power Units	2	41	1	2.44	6.01

*Carriers that did not report any power units on their initial MCS-150 were assigned a single power unit for the purpose of this statistical analysis.

Table 8 shows crashes stratified by count of power units for the control group new entrants.

Table 8. Crashes per power unit for control group new entrants.

Group	Carriers in the Control Group	Reported Power Units	Crashes	Crashes Per Hundred Power Units	Average of All Crashes Per Hundred Power Units
No Reported Power Units	102	102	24	23.53	23.53
1 Reported Power Unit	4,573	4,573	618	13.51	13.73
2–4 Reported Power Units	1,418	3,550	283	7.97	11.25
5–9 Power Units	266	1,639	104	6.35	10.43
10–14 Power Units	75	896	40	4.46	9.93

3.2.2 Carriers' Drivers' Crash Rate

This section presents results of applying a driver-centric exposure for evaluating crash rate risk. This driver perspective is a very powerful and discriminating way to look at crash rate. This measure is described more fully in Appendix E. Because this is a driver-centric measure, the analysis includes all of the crashes that the carriers' drivers had (including crashes when driving for other carriers), not just crashes that the drivers had when driving for the target group carriers. With this increased measure of crash exposure, the researchers were able to separately analyze the homework and the no-homework trained carriers.

3.2.2.1 Exclusion of Crashes Connections

The key to the effectiveness of a driver-centric measure was to connect drivers to all the carriers for which they drove. The original plan was to use every connection that was obtained through both inspections and crashes. If the connections did not introduce a bias to the results, then using every possible connection was the preferred approach for this measure.

However, it turned out that there were two potential biases that needed to be removed.

- At the time this report was written, the researchers planned to analyze whether there was any difference in CDL convictions or suspensions according to what new entrant target group the driver worked for. In order to avoid any bias that might be introduced to later analyses of driver data, the researchers needed to ensure that they used only data for drivers where there was a reasonable chance to match CDL numbers. Therefore, only records containing properly formatted DLNs were included in the analysis.

- More significantly, including association of the drivers with the target groups by crashes appears that it could induce a bias. The data suggesting the possibility of a bias are presented in Table 9.

Table 9. Sources of connections of drivers to carriers.

Measure	Montana Trained Carriers	Control Group Carriers
Inspected Drivers	431	12,715
Drivers in Crashes With Valid DLNs	24	931
Drivers in Crashes With No Inspections	6	318
Total Carriers' Drivers	437	13,033
Percent of Carriers' Drivers With Crashes and No Inspection	1.37%	2.44%

The data in this table indicates that 2.44 percent of the driver associations with control group new entrants would have been associated through crashes, while only 1.37 percent of the associations between Montana trained new entrants and their drivers could have been through crashes.

While on the surface this does not appear to be a large difference, the significance can be seen more clearly when considering the percentage of crash drivers identified only through the crash, as opposed to the percentage of crash drivers that could have been associated through an inspection.

For this analysis, if crashes were used to identify the carrier's drivers:

- 25 percent of the drivers who actually had crashes for Montana trained new entrants would have been identified only by crashes (6 of 24).
- More than 34 percent of the drivers who had crashes for the control group new entrants would have been identified only by crashes (318 of 931).

These are very different values. Therefore, in order to take the most conservative approach possible, the analysis was performed using only drivers connected to new entrants through inspections.

3.2.2.2 Results—Carriers' Drivers' Crash Rate

In the analysis above for carrier-centric crash rate, all Montana trained new entrant motor carriers had to be grouped together. This was because under the measure "Crashes per Power Unit," there were only 24 crashes attributed to the trained new entrant carriers. However, under the measure "Carriers' Drivers," there were 27 crashes attributed to drivers who were associated with the trained new entrants—17 for homework and 10 for no-homework. While this is a small additional difference, it was determined it made it possible to evaluate homework and no-homework new entrants separately.

Table 10 below shows "Carriers' Drivers' Crash Rate" calculations for carriers' drivers using only the crash associations established via crashes that also included inspection data. Again, the start date for including crashes is January 1, 2006 to the end of the original data extraction period of August 2009.

Table 10. Carriers' drivers' crash rates.

Measure	Control Group Carriers	Montana Homework Carriers (Significance Level)	Montana No-Homework Carriers
Total Number of Drivers	12,715	278	153
Total Number of Drivers in Crashes	1,288	17	10
Total Number of Crashes for Carriers' Drivers	1,427	***17 (98%)***	10
Total Crashes While Driving for the Target Group	618	11	5
Average Number of Crashes Per Driver	0.112	***0.06 (98%)***	***0.065 (95%)***
Average Number of Crashes Per Driver When Driving for the Target Group	0.049	0.040	0.033
Percent of Crashes for Target Group	43%	65%	50%

3.2.2.3 Carriers' Drivers' Crash Rates

This driver-centric metric connects all crashes a driver is associated with to each carrier for which the driver worked. Thus, the "Carriers' Drivers' Crash Rate" has an implied measure of exposure. In this analysis, the driver is assigned the exposure of the study period.

Control Group

There were 12,715 drivers associated with control group new entrants by inspection. Of these drivers, 1,288 had a total of 1,429 reportable crashes during the study period while driving for any motor carrier. This amounts to an average of 0.112 crashes per driver during the study period.

Overall, control group new entrant drivers experienced 43 percent of their crashes when driving for a control group new entrant and 57 percent when driving for any carrier other than a control group new entrant.

No-homework Group

There were 153 drivers associated with no-homework new entrants by inspection. Of these, 10 drivers each had 1 crash, for a total of 10 crashes. This amounts to 0.065 crashes per no-homework new entrant driver. While much less than the number of crashes per carrier's driver for control group new entrants, this difference is, along with the small number of new entrants, not quite enough to meet the threshold of 98-percent statistical significance commonly used in this project. The difference would be considered statistically significant at the 95-percent confidence level.

Overall, no-homework new entrant drivers experienced 50 percent of their crashes when driving for a no-homework group new entrant, and 50 percent when driving for any carrier other than a no-homework new entrant.

Homework Group

There were 278 drivers associated with homework new entrants via inspection. Of these, 17 drivers had a crash during the study period. For all homework new entrants, this is 0.061 crashes per driver. This is a statistically significant difference from the control group at the 98-percent level. Thus, drivers associated with Montana homework new entrants had a significantly better overall carriers' drivers' crash rate than drivers associated with control group new entrants.

Overall, homework carriers' drivers had 65 percent of their crashes when the driver was identified as driving for the homework new entrant, and only 45 percent when driving for any carrier other than a homework new entrant.

Drivers for the control group new entrants had a crash rate of about 80 percent more than drivers for either of the groups of Montana trained new entrants.

Nationwide All Carriers' Drivers Comparison

There were 3,158,336 drivers with validly-formatted DLNs who had inspections in the identified timeframe. Of these, 253,259 drivers had crashes accompanied by an inspection. These drivers had a total of 275,610 crashes. (Several of the drivers had more than one crash.) Overall, the drivers with validly-formatted DLNs had an average of 0.087 crashes per driver (275,610 crashes divided by 3,158,336 drivers).

- The crash rate of 0.112 for control group new entrants' drivers is substantially higher than the national average of 0.087 crashes in the same time period. This is consistent with the assertion that new entrants and their drivers are less safe than experienced carriers.
- The carriers' drivers' crash rates for Montana homework (0.061) and no-homework (0.065) new entrants are both better than the national rate for more experienced carriers. This further demonstrates the value of early, proactive training.
- Although 0.61 is better than a crash rate of 0.87, because of the limited sample size for homework and no-homework new entrants, their carriers' drivers' crash rates are not statistically significantly better than the national driver crash rate at the 98-percent level, but they are at the 95-percent level. So, although it cannot be stated that their crash rate is better than the national average, it can be stated that as a result of the training, the crash rate performance for the Montana trained new entrants was at least as good as the national average for experienced carriers. Presumably, this was the desired intention of Congress when it created the New Entrant Program.

Thus, for the more important measure of crashes, there is an even clearer improvement in safety performance than for roadside inspections:

- The safety performance crash rate of the homework new entrants (or, in this case, the performance of the drivers associated with the homework new entrants) was statistically significantly better than the performance of the control group new entrant drivers.
- The safety performance crash rate of the no-homework new entrants would have been found statistically significantly better if the researchers were using the relatively common 95-percent standard instead of the more stringent 98 percent standard.
- The safety performance crash rate of both the homework and no-homework new entrant drivers was so improved that it was at least as good as the rate for the overall population of drivers.

3.2.2.4 Summary

Advantages of Carriers' Drivers' Crash Rate

The data quality of the driver-centric "Carriers' Drivers' Crash Rate" measure should be better than the carrier centric measure, because "Carriers' Drivers' Crash Rate" is based only on State-reported observed actual data. This data identified a significant performance difference between the homework new entrants' drivers and the control group new entrants' drivers. The data quality of the traditional crash-related measure (carrier-centric "Crashes Per Power Unit") is known to have problems, because it is based on both State-reported actual data and carrier self-reported power unit data. It yielded results indicating the same direction of differences, but not as clearly.

The key difference between the driver-centric "Carriers' Drivers' Crash Rate" and the carrier-centric "Crashes per Power Unit Rate" is that the Carriers' Drivers' measure is based on an entire accounting of all the drivers' crashes during the analysis period (i.e., while working for all carriers). Including all the driver's crashes creates an inclusive representation of the overall safety performance behavior of each driver. This is the crash risk the carrier takes on when they hire that driver.

Staying With Same Employer

This measure is also especially useful in identifying the behavior of the driver's employment. Namely, what percent of drivers remain employed by the same new entrant group, and thus possibly the same employer? This is seen by looking at the difference in the percent of the crashes that occur while control group drivers are working for the control group versus the percent of crashes while homework drivers are working for homework new entrants. It has already been established that homework new entrants have a better crash rate. Additionally, drivers for homework new entrants experienced most of their crashes while working for homework new entrants as opposed to while working for all other carriers:

- Homework new entrants' drivers had 65 percent of their crashes (in the January 2006–August 2009 timeframe) while working for the homework new entrants.
- No-homework new entrants' drivers had 50 percent of their crashes while working for the no-homework new entrants.
- Control group new entrants' drivers had only 43 percent of their crashes while working for the control group new entrants.

Thus, the driver-centric rate of crashes per driver associated with the new entrant groups (the "Carriers' Drivers' Crash Rate" metric) also enabled researchers to determine whether there appears to be a lower driver turnover with adoption of a safety culture. These data suggest a rather strong correlation between new entrants adopting a safety culture, driver retention, and improved safety performance of their drivers. Thus, new entrant motor carriers can effectively improve both the safety performance behavior of their drivers and driver retention by adopting a safety culture.

When using the carrier-centric measure of crashers per power unit, the total crash behavior of the drivers being hired by those carriers is more hidden. This is because under the carrier-centric method, the higher the driver turnover rate, the more of those drivers' crashes are associated with other carriers. Thus, calculation of the carrier crash rate per power unit only uses part of the available data for those drivers. While this metric detects the difference in safety performance, it is less able to discern whether the difference between the control group and the trained new entrant group is statistically significant.

The lower driver turnover rate among homework new entrants also suggests that an operational reason for the low attrition rate may be higher employee satisfaction. A possible reason is that the safety culture fostered by the 2005–06 training positively influenced drivers to prefer working for those carriers. An applicable paraphrase from TRB Synthesis Report 14 is, "Both empirical and anecdotal evidence … support that "safe" carriers … produce, attract, and retain safe drivers." The carriers' drivers' metric for this analysis provides an empirical measure that corroborates the validity of that statement.

Thus, the carriers' drivers' crash rate statistic—in addition to providing insight into success of fostering a safety culture in trained new entrants—also provided some insight as to how the improved safety culture works. One element of the safety culture is an improved retention level of safer drivers with trained new entrants, especially for the group of homework new entrants.

3.2.3 Additional Comparative Statistics—Drivers with Multiple Crashes

In the analysis period there were 12,715 drivers associated (identified with validly-formatted DLNs) with the 6,434 control group new entrants (through inspection). Of these, 1,288 drivers had a total of 1,429 crashes. This is made up of 1,155 drivers (0.8967) who had single crashes, 125 (0.097) who had 2 crashes each, and 8 (0.0062) who had 3 crashes each.

Through inspections, the Montana trained new entrants (homework and no-homework new entrants together) had 431 drivers associated with them.

If the drivers associated with Montana trained new entrants had crashed at the same rate as drivers associated with the control group new entrants, then approximately 43.66 drivers would have had a total of 48.44 crashes. This would have been comprised of 39.15 drivers who would have had single crashes, 4.24 drivers who would have had 2 crashes, and 0.27 drivers who would have had 3 crashes.

However, the data show that for drivers associated with the trained new entrants, only 27 had crashes while driving for any motor carrier.

If those 27 drivers had crashed at the same rate as the control carriers' drivers, then 2.62 of those drivers would have had 2 crashes, and 0.17 of those drivers would have had 3 crashes, for a total of 29.96 crashes. However, those 27 drivers had only 27 crashes. No drivers that were inspected while working for Montana trained new entrants had more than one crash during the data collection time period while driving for any motor carrier.

Due to the small sample size, these additional comparative statistics are not statistically significantly different at the 98-percent level. However, the data trend is consistent with the above findings. These comparisons also strongly support the assertion that drivers who were ever associated with Montana trained new entrants had better overall crash performance than drivers ever associated with control group new entrants. This is yet another indication of the value of training and testing in fostering adoption of a safety culture in new entrant motor carriers.

3.3 PROJECTED SAFETY AUDIT RESULTS

One important reason why FMCSA undertook the original 2005–06 training of new entrants was to determine if it would lower the number of new entrants expected to fail the upcoming stricter SA. For this reason, an analysis was performed to determine (for trained new entrants) the projected SA pass rate under the final rule.

3.3.1 Summary Safety Audit Results

FMCSA issued new standards for passing the SA in a final rule in December 2008, with required compliance beginning in December 2009. Table 11 provides an analysis of SAs performed on new entrants in each of the three target groups based on data for each of the questions from the actual SA results. Researchers retroactively projected what would have been the result under the standards from the final rule. The results show:

- Total number of new entrants that received SAs within each group.
- Total number of new entrants within each group retroactively projected that would have failed, based on analysis of the 16 automatic failure criteria contained in the new entrant final rule and the existing enforcement policy.
- Percent of new entrants within each group that would have failed the SA.

The results demonstrate that even the first-generation simple training curriculum applied in 2005–06 was highly successful in improving the retrospectively imputed pass rate under the 2008 final rule for homework group new entrants. These are the groups that took the instruction seriously, did the hands-on reinforcing homework, and provided it for review and comments.

Table 11. Impact of training on failure rate of safety audit.

New Entrant Group	Total Safety Audits	Number of Carriers That Would Fail With New Criteria	Percent of Carriers That Would Fail With New Criteria (Significance Level)
Montana Homework New Entrants	96	29	30% **(99.9%)**
Montana No-Homework New Entrants	87	46	53%
Control Group New Entrants	4,911	2,906	59%

Researchers compared the number of new entrants in each target group that would have failed, based on the final rule new criteria and the enforcement policy issued for that rule. The projected number of Montana homework new entrants that would have failed is dramatically and statistically significantly lower than would have been expected if Montana homework new entrants had been picked randomly from control group new entrants.

The number of Montana no-homework new entrants that would have failed is slightly lower than would have been expected if Montana no-homework new entrants had been picked randomly from control group new entrants. However, the difference is not statistically significant.

Among the control group's smallest new entrants (those with four or fewer power units), the failure rate is projected at approximately 59 percent. Among the control group's larger new entrants (those with 5–15 power units), the failure rate is projected at 42 percent. However, there are so few new entrants with more than four power units that this percentage has almost no impact on the projected overall failure rate of 59 percent, which was driven primarily by the large number of smaller new entrants. This difference for larger new entrants is consistent with findings from TRB Synthesis Report 14, namely that larger carriers have more resources to devote to safety considerations—in this case for passing the SA.

3.3.2 Safety Audit Conclusions

This analysis of the first-generation training curriculum provided to Montana new entrants in 2005–06 indicates that the training reduced the percentage of new entrants that would have failed the SA under the policy implemented with the final rule. The difference is especially pronounced for the group that was successfully convinced to voluntarily perform the recommended hands-on, reinforcing homework and have it critiqued. Reducing the number of failed audits would provide additional benefits to both new entrants and the Government.

When a new entrant fails a SA:

- The new entrant is required to develop and provide a CAP to the FMCSA service center responsible for that State.
- Employees at FMCSA service centers are responsible for reviewing the CAP and determining if it is sufficient for not rescinding the new entrant's interstate USDOT number.
- The new entrant carrier must implement the CAP.

- FMCSA staff in the new entrant's State (or the State MCSAP staff) must monitor and verify continuing compliance with the CAP.
- If the new entrant does not provide an acceptable CAP, or is subsequently found not to be in compliance with the submitted CAP, FMCSA must rescind the new entrant's USDOT number.

Reducing the SA failure rate would reduce these costs for both new entrants and FMCSA.

Table 12 provides an estimate of the reduction in SA failures as a result of training, if implemented nationwide. However, at least three things are changing these projected numbers:

- First, new entrants understood that it is more important to prepare for the SA, as the failure rate was less than originally predicted, and it is decreasing because new entrants are better prepared.
- Second, early indicators from the revised second-generation research curriculum indicate that the percentage of new entrants that are completing the recommended voluntary hands-on reinforcing homework is much higher than was the case in the 2005–06 training.
- Third, on April 8, 2011, FMCSA revised its policy regarding failure criteria for the SA. Essentially, the policy now states that if the new entrant had failed one of the automatic criteria and had documented that it fixed the failure by the time of the SA, then the new entrant would not fail the SA nor have to prepare a CAP.

Thus, Table 12 is only an illustration that early, proactive training can produce a significant reduction in new entrant failures of their SAs, based on the first-generation simple training program in Montana.

Based on lessons learned from the first-generation curriculum and training theories, the 2010–12 second-generation curriculum includes additional measures that seem to have more effectively convinced a much greater percentage of the new entrants to voluntarily perform the hands-on, reinforcing homework and have it critiqued. Initial results from the 2010–12 research demonstration are that approximately 85 percent were voluntarily performing the reinforcing homework, versus 52 percent with the 2005–06 curriculum. Thus, it is anticipated that the safety performance data for the 85 percent of new entrants in the 2010–12 research will corroborate adoption of a safety culture in this even larger percentage of new entrants.

Based on results from the first-generation training and preliminary results from the 2010–12 second-generation training, the researchers recommend creating and testing a third-generation curriculum. Details pertaining to that recommended curriculum, which is being pursued by FMCSA, are included in Section 9 of this report.

Table 12. Estimated reduction in safety audit failure from new entrant training.

Factor	Estimate
Approximate Number of Safety Audits Per Year	40,000
Expected Failure Rates Without Training	
Percent of New Entrants That Would Fail the Safety Audit Without Training *	59%
Number of New Entrants That Would Fail the Safety Audit Without Training	23,600 (59% of 40,000)
Expected Failure Rates With Training Program	
Percent of New Entrants That Did the 'Homework'	50%
Number of New Entrants That Would Do the 'Homework'	20,000 (50% of 40,000)
Percent of Homework New Entrants That Would Fail the Safety Audit	30%
Number of Homework New Entrants That Would Fail the Safety Audit	6,000
Percent of New Entrants That Did Not Do the 'Homework'	50%
Number of New Entrants That Would Not Do the 'Homework'	20,000 (50% of 40,000)
Percent of No-homework New Entrants That Would Fail the Safety Audit	53%
Number of No-homework New Entrants That Would Fail the Safety Audit	10,600
Total Number of New Entrants That Would Fail Their Safety Audit, With a Training Program	6,000 + 10,600 = 16,600
Number of Additional New Entrants That Would Pass the Safety Audit, Based on the 2005–06 First-generation Training Curriculum	23,600 - 16,600 = 7,000

*Since the compliance date of December 16, 2009, FMCSA is seeing a declining rate of failure nationally from this retrospectively-projected rate. Also, there was a policy change that lowers the failure rate.

These figures suggest that even application of the first-generation curriculum nationally could reduce new entrant SA failures by 7,000. As stated above, implementation of the recommended third-generation curriculum should produce even better results.

3.3.3 Detailed Analysis of Projected Safety Audit Failure Rates Based on New Failure Criteria in Final New Entrant Rule and the Original Policy

As specified in the December 2008 final rule, there are 16 questions from the SA identified as automatic failure criteria in the FMCSRs.

Table 13 below shows each question identified as SA failure criteria, and the number of new entrants in each target group that would have failed the SA by question under the new final rule and policy. The total number in each column is more than the total number of new entrants that would have failed the SA. This is because some new entrants would have failed on more than one question.

Table 13. Safety audit questions that will result in failure, with new regulations.

FMCSR Citation	Safety Audit Question	Safety Audit Question Number	Count of Control Group Carriers That Would Have Failed on the Question	Count of Montana Homework Carriers That Would Have Failed on the Question	Count of Montana No-homework Carriers That Would Have Failed on the Question
387.7(a) 387.31(a)	Does the carrier have required minimum levels of financial responsibility?	1	19	0	0
391.11(b)(4)	Is the carrier using physically qualified drivers?	8	0	0	0
391.15(a)	Is the carrier using disqualified drivers?	10	0	0	0
382.115(a) 382.115(b)	Has the carrier implemented an alcohol and/or controlled substances testing program?	12	1,333	12	6
382.215	Has the carrier used a driver who has tested positive for a controlled substance?	14	0	0	0
382.201	Has the carrier used a driver with an alcohol concentration ≥ 0.04?	15	0	0	0
382.305	Has the carrier implemented a random testing program?	19	315	0	0
382.211	Has the carrier used a driver who has refused a blood alcohol test or controlled substance test?	25	0	0	0
383.23(a)	Has a driver operated a CMV without a current operating license, or a license which hasn't been properly classed and endorsed? (Note: Question 27 was renumbered as Question 89.)	27 89	8 22	0	0
383.37(a)	Do drivers with suspended/revoked/ canceled CDLs drive?	28	2	0	0
383.51(a)	Has the carrier allowed a disqualified driver to drive?	29	1	0	0

FMCSR Citation	Safety Audit Question	Safety Audit Question Number	Count of Control Group Carriers That Would Have Failed on the Question	Count of Montana Homework Carriers That Would Have Failed on the Question	Count of Montana No-homework Carriers That Would Have Failed on the Question
396.17(a)	Can the carrier produce evidence of periodic inspections?	31	1,711	28	23
396.11(c)	Does the carrier ensure OOS defects on Driver Vehicle Inspection Reports are corrected?	33	5	0	0
396.9(c)(2)	Does the carrier ensure vehicles declared OOS have repairs made?	34	4	0	0
395.8(a)	Does the carrier require drivers to make a record of duty status? (Note: Question 37 was renumbered as Question 90.)	37 90	158 817	1 9	1 6

The retrospectively-projected failures under the final rule new requirements are predominantly for only a few questions. These questions are straightforward and are being addressed in the 2010–12 research demonstration training project. This project is training new entrants on what is required, and thus how not to fail those questions on the SA, especially under the new policy issued on April 8, 2011.

That policy established that the new entrant will not fail the SA if the new entrant has fixed the reason for failure by the time of the audit. Thus, early training and testing could substantially impact the failure rate under this revised policy. Future mandatory initial training under authority of the provision of MCSIA 210(b) could virtually eliminate failures.

3.3.4 Potential Impact of the Note to 49 U.S.C. 31144 Created by MCSIA Section 210(b)

If new entrants are required to receive standardized training and pass a proficiency test as a condition before being issued an interstate USDOT number, they would be made explicitly aware of the regulations with which they must comply. Under such a program, the new entrant would have already been made aware of the FMCSR requirements through initial contact with FMCSA, or their representative. Thus, the current regulatory specification for an SA that only requires a CAP upon discovery of noncompliance with a significant requirement should be revised to instead become some type of enforcement action against the non-compliant trained and tested new entrant.

The rationale for this is based on the assertion (by FMCSA’s former manager of the CSA program) that most carriers want to do the right thing. Thus, if FMCSA requires training and testing before the new entrant is granted an interstate USDOT number, then future detection of failure to comply with a major requirement is more likely to be a true compliance issue.

As CSA plans to do with a voluntary Cooperative Safety Plan (CSP), it might be appropriate to institute requiring a CAP (or CSP) for minor issues for which the new entrant is still not in compliance. However, if the new entrant is not in compliance with one of the significant requirements, perhaps the remedy should become some other more stringent form of enforcement.

Another possible advantage that could follow from mandatory training and testing would be to prevent those who cannot successfully pass the training and testing from ever being issued a USDOT number. Part of the poor safety performance by new entrant carriers is explained by very unsafe new entrants that go out of business, leaving those that are safer. A mandatory training and testing requirement might prevent some of those extremely unsafe new entrants from ever being issued a USDOT number.

3.4 CARRIER PERFORMANCE IN COMPLIANCE REVIEWS

The peer review committee for the second-generation research demonstration was interested in analysis of CRs to determine if any information could be gleaned from CRs performed on new entrants. Analysis of this measure did not produce any clear results.

First, new entrants transporting commodities that require a Hazardous Materials Safety Permit (HMSP) from FMCSA must receive a CR rather than a SA in order to qualify for their HMSP. Thus, the reason for the CR is different. Second, other than CRs for new entrant HMSP carriers, most CRs are conducted because the motor carrier came to the attention of FMCSA due to safety performance data, a complaint, or violation of one of the seven expedited actions (after having completed an SA but while still considered a new entrant). Thus, if the SA has already been conducted and the new entrant is identified via roadside inspection as violating one of the seven expedited actions, then a CR might be scheduled. However, in general, as discussed earlier, very limited safety performance data is accumulated for individual small motor carriers. Thus, a CR for a non-HMSP new entrant more likely means that that specific carrier was targeted because of a crash, which relatively speaking is also a rare event. So, there are conflicting reasons for performing a CR on a new entrant. All HMSP new entrants get a CR. Non-HMSP new entrants rarely get a CR since significant crashes are relatively rare events, and most do not accumulate enough safety performance violations to get targeted by SMS.

Table 14 shows results for CRs for control group, homework and no-homework Montana new entrant motor carriers.

Table 14. Compliance review results.

Safety Rating	Control Group	Control Group Percent	Control Group Percent Excluding Unrated	Montana Homework Carriers	Montana Homework Carriers Percent	Montana No-homework Carriers	Montana No-homework Carriers Percent
Conditional	182	31.9%	34.5%	6	40%	4	44%
Satisfactory	291	51.0%	55.1%	9	60%	5	56%
Unsatisfactory	55	9.6%	10.4%	0	0%	0	0%
Unrated	43	7.5%	0%	0	0%	0	0%
Total CRs	571	N/A	N/A	15	N/A	9	N/A
Total Carriers in This Group	6,434	N/A	N/A	117	N/A	104	N/A
Percent of Carriers Who Received CR	9%	N/A	N/A	13%	N/A	8%	N/A

The reason why 7.5 percent of the control group new entrants did not receive ratings in their CRs is unknown. However, given that there were only 24 CRs on Montana trained new entrants, the fact that none of the reviews lacked a rating is not statistically significant.

A visual inspection suggests that homework new entrants did slightly better in their CRs than control group new entrants. However, the number of CRs is too small to generate statistically significant results.

None of the Montana trained new entrant motor carriers (of either subgroup) received an unsatisfactory rating. Slightly more than 10 percent of the control group received a rating of unsatisfactory. This is a distinct difference. However, because of the very small numbers, the difference is not statistically significant.

3.5 COMPLIANCE, SAFETY, ACCOUNTABILITY

FMCSA developed a new operational model for its CSA initiative. Evaluating carrier performance through SMS is critical for ranking carriers who should receive attention.

The SMS methodology applied at the time of this analysis uses seven Behavior Analysis Safety Improvement Categories (BASICs) to rank carriers when there are sufficient data available for one or more of these seven different factors. There are minimum requirements for what constitutes sufficient data within a given timeframe for calculating a rank percentile value on a measurement factor.

3.5.1 CSA Data

FMCSA provided the CSA SMS project with identification data for all the new entrants in both the control group and the trained group.

The SMS methodology, as configured at the time of this analysis, operates at the individual carrier level. FMCSA does not have a version that operates at the group level for comparing groups of carriers, as all of the above analyses for this project did. So for this report, the researchers manually performed an aggregation of results. However, if the analysis were performed as groups, it would be more definitive.

- The SMS methodology is designed to provide comparison percentile rankings of individual carriers among similarly-sized carriers. Its purpose is to assist in identifying where enforcement efforts should be directed. It is not designed as a research tool to compare performance of different groups of carriers against each other.
- The SMS methodology is also designed to rank only those carriers for which enough data have been collected to provide a more stable percentile ranking of safety performance. Thus, it imposes a set of controls to assure data sufficiency. For the vast percentage of small carriers, which includes the new entrants involved in this study, FMCSA does not obtain sufficient data for SMS to individually rank most of them. That is the reason why the majority of this analysis used performance of groups of new entrants, not individual motor carriers.
- Even though there was only enough data for SMS to rank a very small number of individual new entrants in each group, the implications of the results are still very comparable to the findings using other analysis techniques for all three groups (i.e., the results are consistent with what was found using the pooled data on the groups' safety performance measures above).
- Thirteen of the 117 homework new entrants (11 percent) had sufficient data for SMS to calculate 1 BASIC ranking. Five of the homework new entrants (4 percent) had sufficient data for SMS to calculate two or more rankings.
- Five of the 104 no-homework new entrants (4.8 percent) had sufficient data for SMS to calculate 1 BASIC ranking. Four of the no-homework new entrants (4 percent) had sufficient data for calculating SMS ranking on two or more BASICs.
- Of control group new entrants, 576 (9 percent) had sufficient data for calculating 1 BASIC ranking, and 311 (5 percent) had sufficient data for calculating SMS rankings for 2 or more BASICs.

The following logic was applied to approximate what the SMS results indicate about each of the three groups. There were two BASIC categories where more than one homework new entrant had rankings: the Fatigued Driver BASIC and the Vehicle Maintenance BASIC. A BASIC score for each new entrant with sufficient data is derived as a total of time- and severity-weighted events divided by an exposure factor.

In each of the above two BASIC categories, the average of the individual BASIC percentile scores for the homework new entrants, was less (better) than the average of the individual BASIC percentile scores for control group new entrants. This shows that for the few new entrants with enough data observations to calculate a BASIC score, the average SMS BASIC rankings for the homework group were still better than the average for control group new entrant motor carriers 4 or more years after the training.

Similarly, these same two BASIC categories were the only ones where more than one no-homework new entrant had a BASIC ranking. On the Vehicle Maintenance BASIC, the average of the individual BASIC scores for no-homework new entrants was 20 percent less than the average of the individual BASIC scores for control group new entrants.

However, on the Fatigued Driver BASIC, the average of the individual BASIC scores for no-homework new entrants was 3 percent higher than the average BASIC scores for control group new entrants. This is consistent with what the pooled data indicated.

Because of the low number of trained new entrants with SMS scores, no conclusions can be drawn from this finding. However, one can observe that even though it is less definitive, the general pattern of safety performance after 4 years still appears comparable to the results from the pooled group data.

3.5.2 Updated Roadside Performance Results

The data provided with the SMS BASIC results included additional supporting data for 2009–10 (the timeframe used for calculation of the BASIC scores published in January 2011). These more current data augmented the data contained in the MCMIS extract made in August 2009. From the additional 2009–10 data, it was possible to calculate updated values for percent of inspections resulting in driver OOS orders, and percent of inspections resulting in vehicle OOS orders.

Just as the SMS BASIC results indicated above, the updated results of the pooled data continued to indicate a persistent, lasting change in the safety performance of the new entrants that received training in 2005–06. For example:

- On the measure "Percent of Inspections Resulting in Vehicle OOS Orders," both groups of Montana trained new entrants continued performing better than control group new entrants. However, the difference in performance was not sufficient to overcome the small number of new entrants involved, and these differences are not statistically significant.

- On the measure "Percent of Inspections Resulting in Driver OOS Orders," both groups of Montana trained new entrants continued performing substantially and statistically significantly better than performance of the control group. Inspections on Montana trained new entrants resulted in one-third fewer driver OOS orders than did inspections on a similar number of control group new entrants. For homework new entrants, the differences are significant at the 99.9-percent confidence level. The differences for the no-homework new entrants are significant at the 98-percent level.

- On the critically important measure of "Carriers' Drivers' Crashes," both homework and no-homework new entrants continued to perform statistically significantly better than the control group.

PART I (B) FINDINGS FROM THE SECOND-GENERATION CURRICULUM

4. OVERVIEW

4.1 BACKGROUND

The analysis in this section is an analysis of the safety performance of new entrants who participated in the 2010–12 second-generation research demonstration. Like the first-generation curriculum, the second-generation curriculum was also applied in Montana. This was done to keep as many variables as possible the same, also allowing the ability to compare the effectiveness of the second-generation curriculum with that of the first.

The primary goal of the second-generation research demonstration was to foster the adoption of a safety culture via training and testing. Secondary goals were to:

- Increase the SA pass rate.
- Increase the percentage of new entrants that choose to adopt a safety culture, thus improving trained new entrants' safety performance metrics related to inspections and crashes.
- Increase the percentage of new entrants that remain in business.

Improvements Applied to the Second-generation Training

Building on lessons learned from the first-generation training, the project team deliberately made improvements to the second-generation curriculum that were intended to increase the trained new entrants' homework-completion/mock audit participation rate.

One of these improvements was to designate the training entity as the official who would validate of all the new entrant applicants in Montana (as opposed to the national validation contractor). This established an official contact between the training entity and those carriers and created an opportunity for the training entity to offer the free new entrant training on an individual basis. It is worth noting that even though the training entity was named in the official letter that FMCSA sent to each of the new entrants, some of the new entrants still believed the contact was attempting to scam them and they refused to participate in the validation.

This process (i.e., having the trainer validate all of the Montana new entrants) allowed the trainer to keep a detailed record of all Montana new entrants who accepted (i.e., scheduled a training session) or declined the training and testing. This allowed analysts to compare the safety performance of the second-generation trained new entrants to that of the new entrants who declined the training and the control group. It also provided the opportunity to determine if the safety performance of Montana new entrants that declined the training was similar to that of the new entrants in the control group.

Other improvements applied to the second-generation curriculum are as follows:

- The curriculum was made more detailed and complete.
  - A PowerPoint presentation was developed.
  - A carrier library was developed.
  - More detailed handouts were prepared.
  - The motor carrier safety kit was enhanced to include detailed written instructions for each form the carrier was responsible for completing.
    - All these materials were put on a Web site for reference and future use. They were also put on a CD for availability via Montana's labor offices libraries.
- All attendees were given hard copies of all required carrier files.
- A test was conducted prior to training, immediately after training, and at 1 year to measure retention.
- The training was conducted in peer groups to promote peer reinforcement, rather than via the one-on-one arrangement used in the first-generation training and testing.

Additionally, various macro things changed from the 2005–06 curriculum training to the 2010–12 curriculum training. These included:

- The final rule for new entrant motor carriers' safety assurance was issued on December 16, 2008, and became effective on February 17, 2009. An intended purpose was to "raise the bar" for passing the SA.
- In July of 2010, FMCSA implemented the new CSA Program, which replaced the CSA2010 operational test model. So while the above-mentioned new entrant final rule was in effect, the new entrant training began 1 month after the rollout of the CSA Program. State and Federal resources were thus focused on training all motor carriers on how to be compliant with CSA. As a consequence, fewer SAs were being conducted during that time and backlogs developed. Through word of mouth from other new entrants about the State's delay in performing SAs, subsequent new entrants were influenced not to bother with the training at all.
- The Bakken oil-shale formation development turned into a boom in eastern Montana. As such, it had a much larger impact on the 2010–12 training than it did on the 2005–06 training, and it became a major economic driving force. Congestion in the eastern part of Montana, where many of the new entrants were concentrated because of the oil fields work, made it impossible for enforcement officials to conduct roadside inspections in that part of the State.
- The operating environment in eastern Montana was highly driven by economics of the oil boom, which was not compatible with a safety-first mission. There was considerable pressure for carriers to cut corners, especially given the lack of enforcement in that part of the State. Thus, it was a very difficult environment in which to foster adoption of a safety culture.

- Another impact of the Bakken oil-shale development was that for a time, a very high number of new entrants were living closely in dormitories. Thus, they communicated much more frequently than usual, sharing their perceptions of the enforcement programs.
- Following the CSA rollout, the State carried out an enforcement strike force that quickly conducted a large block of SAs in eastern Montana. The SAs performed by this enforcement strike force were more simplistic due to time restraints and guidance to reduce the number of submitted CAPs.
- On the inspection front, there appears to be a shift in multiple States toward conducting initial screenings of vehicles and drivers to decide if an inspection should be conducted. Screening technology, such as heat sensors that detect out-of-adjustment brakes on large trucks, is beginning to be deployed. Typically, most States do not report screening information to MCMIS. This is causing a shift in what inspection data is reported for monitoring safety performance (i.e., if a State is screening, then that State only reports inspections with violations).
- The time elapsed from the end of the second-generation training (2010–12) to when the analysis had to be performed was a bit shorter than it was for the first-generation training (2005–06). As a result, less safety performance data was accumulated.
- The amount of resources available to States for assistance in performing SAs has varied over the years. For a short period, FMCSA inspectors that were originally hired to perform border inspections could travel to assist States that had a SA backlog. More recently, FMCSA funded a short, one-time contract to provide inspectors who would travel to States that had a backlog and assist them as needed. Montana did not have access to either of those options during the second-generation training and testing. Federal grant funds available to assist the States remain fixed.
- Due to the limited resources of the FMCSA Service Centers to process the large number of CAPs being generated, FMCSA adopted other ways to help new entrants comply with the SA. The new approaches were developed to allow inspectors to complete the mandated SAs within the required 18-month period (reduced to 12 months by MAP-21) and to reduce the number of CAPs required to be submitted to the Service Centers for review. As a result, new entrants began to have the perception that the SA was little more than required paperwork that would have minimal impact on their operations. Thus, their incentive to complete the training was diminished.
  - **Note:** Just as was found for the first-generation training, if the voluntary training and testing applied in Montana were applied nationally, under the current system it would free up desperately needed FMCSA Field staff for other functions. However, if the proposed third-generation training is mandated under the MAP-21 requirement, the proposed new system would eliminate the need for CAPs to be reviewed by the Service Centers. This is because if a desired new entrant does not pass the proficiency test after the training, they would have to undergo remedial training, and if they do not pass then, they would not receive a USDOT number. (The proposed revised system is discussed in more detail later and would have to be part of the mandated

rulemaking to establish the training and testing before receiving an interstate USDOT number.)

These and other things led to a considerably different, volatile, and ultimately less intrusive enforcement environment than existed during the first-generation training. As such, new entrants were not sufficiently incentivized to participate in the voluntary second-generation training.

4.2 CHANGES IN PARTICIPATION OVER TIME

This section explains the conditions that led to the substantial changes in environmental and enforcement activities during the second-generation training. However, these changes in environmental and enforcement activities cannot be disaggregated for separate analysis, and thus it is not possible to determine the impact of individual events.

Carriers' participation in the second-generation training over time was tracked using each carrier's first New Entrant Entry Date. For carriers that had a first New Entrant Entry Date prior to the start of the program, the earliest New Entrant Entry Date after April 1, 2010 was used. (If a carrier left the New Entrant Program and later reentered, the most recently-recorded entry into the program was used as the New Entrant Entry Date. The carrier's history of New Entrant Entry Dates contained in MCMIS was used to determine the appropriate New Entrant Entry Date for this analysis.)

A total of 1,525 Montana new entrants were identified during the second-generation research demonstration and approached by the trainer for validation. Of those, 705 were determined to be intrastate or long-term leased to another carrier (thus operating under the safety program of the other carrier).

Table 15. Percent of eligible Montana new Entrant carriers that accepted training during the 2010–12 second-generation research demonstration shows that 820 new entrants were determined to be eligible for the training, based on the validation process.

Table 15. Percent of eligible Montana new Entrant carriers that accepted training during the 2010–12 second-generation research demonstration.

New Entry Time Frame	Carriers Eligible for Training	Carriers that Declined Training	Carriers That Entered Training	Carriers That Completed Training	Percent of Eligible Carriers That Started Training
Apr–June 2010	22	12	10	7	45%
Jul–Sept 2010	59	24	35	31	59%
Oct–Dec 2010	65	28	37	34	57%
Jan–Mar 2011	80	56	24	15	30%
Apr–Jun 2011	96	55	41	33	43%
Jul–Sept 2011	84	60	24	18	29%
Oct–Dec 2011	59	41	18	16	31%
Jan–Mar 2012	78	64	14	14	18%

New Entry Time Frame	Carriers Eligible for Training	Carriers that Declined Training	Carriers That Entered Training	Carriers That Completed Training	Percent of Eligible Carriers That Started Training
Apr–Jun 2012	79	59	20	18	25%
Jul–Sept 2012	58	52	6	6	10%
Oct–Dec 2012	80	71	9	7	11%
Jan–Mar 2013	60	55	5	5	8%
Total	**820**	**577**	**243**	**204**	N/A

As mentioned earlier in this report, carriers that completed the recommended homework and received a mock audit are called "homework" carriers, and carriers that did not complete the recommended homework and thus did not receive a mock audit are called "no-homework" carriers.

As can be seen in Table 15, there were much higher participation rates earlier in the project (2010–11). As a result, there was more time for those carriers to accumulate safety performance data.

4.2.1 Initial Environmental Elements

The second-generation training program began roughly around the same time that FMCSA was rolling out the CSA Program. Consequently, at the start of the second-generation training program, the carrier community was particularly aware of the potential role of enforcement, and thus of the importance of their safety performance record (which could target them for attention).

The second-generation training program started on July 1, 2010. At that time, and for the duration of the research project, the trainers for this project were assigned the role of completing the validation process for new entrants in the State of Montana. A number of the initial participants were carriers that had requested an interstate USDOT number in the April to June 2010 quarter, and thus some were still within the time window allowed for training.

The general practice was for carriers to schedule and attend the training within 90 days of entering the New Entrant Program. By adhering to this approach, the State had enough time to schedule and complete the new entrants' SAs within the required 18 months. Generally, if the new entrant had not scheduled training within 90 days of their validation date, they were no longer eligible for the training. However, if a carrier had legitimate scheduling or proximity issues, the agreement did allow for exceptions (i.e., permitting up to 6 months for training).

The first training session was held on August 18, 2010. The first mock audits were scheduled in October 2010 for carriers that attended training in August and September of 2010. From that point forward until the following year's end in 2011, the trainer provided training and mock audits in various regions of Montana every 6–8 weeks, and in Billings monthly. Beginning in 2012, training and mock audits continued to be offered in Billings, but not in other areas of Montana.

It appeared that a safety culture was forming by the end of the first quarter of 2011, approximately 9 months after the training program had begun. It was observed that new entrants were actively engaged; promptly responding to calls, making appointments, and prioritizing safety. By March 18, 2011, 15 training sessions had been held across the State: 8 in Billings, 3 in Glendive, 1 in Miles City, 1 in Bozeman, 1 in Great Falls, and 1 in Missoula.

Overall, 56 percent of the carriers with New Entrant Entry Dates in calendar year 2010 (the first three calendar quarters of the project) accepted the training and went through the training process.

Although statistics about the carriers that declined training were not accumulated during the first generation of training, it was observed that during the first 9 months of the second-generation training, the participation rate of the eligible new entrants was much higher than the overall participation rate that had occurred during the first-generation training.

4.2.2 Completion versus Non-Completion

Although the percentage of eligible new entrants who elected to take the training decreased substantially through the course of the second-generation program, a surprisingly high percentage of those carriers who elected to take the training completed their homework and had a mock audit. Consistently throughout the program, about 85 percent of the carriers that started the training completed the recommended homework and received a mock audit.

This contrasts with the lower overall percentage of the first-generation trained new entrants that completed the homework and received a mock audit (52 percent). Thus, the 85 percent completion rate for the second-generation training and testing seems to indicate that the changes made to the second-generation curriculum (that were intended to increase the motivation of the trained new entrants to take the training seriously) were successful. One unintended (and positive) consequence of the high rate of homework completion is that the number of no-homework carriers was so low that it was impossible to draw any statistical conclusions about the safety performance of that group.

4.2.3 A Precipitous Fall-off in Carrier Participation

At the time this research project was conducted, new entrant training and testing was voluntary. Thus, a new entrant's decision to participate in training could be influenced one way or the other by outside forces. In the second-generation training and testing, the project team recorded details and documented changes in potential motivating forces. This documentation showed that there was an uneven—but clear—significant fall-off in carrier participation over the course of the training program.

Figure 3 shows the percentage of carriers that chose to complete the second-generation training, as a percentage of the eligible carriers. The percentage of carriers that completed the homework and received a mock audit was slightly lower.

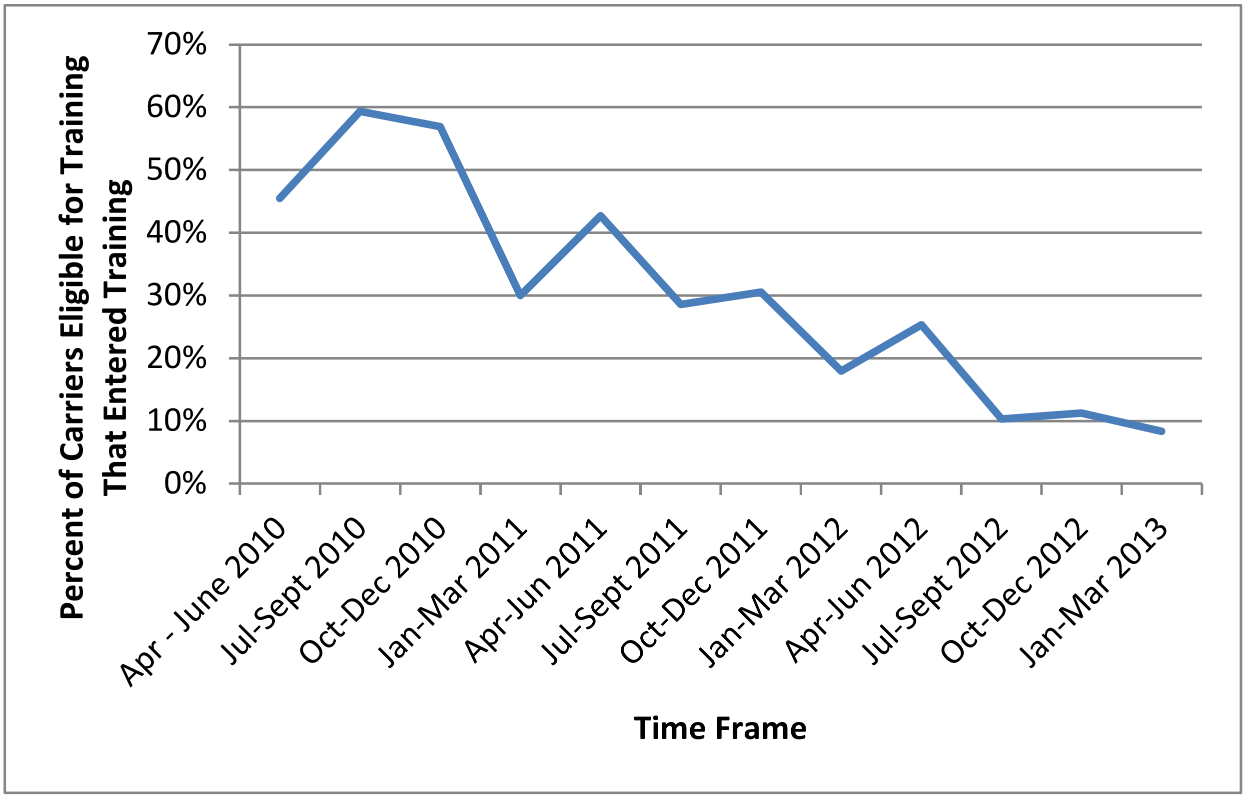

Figure 3. Line graph. Percent of eligible carriers that entered the second-generation training.

Below are a few statistical highlights related to carrier participation rates for the second-generation training and testing:

- 56 percent of the new entrant carriers who obtained a USDOT number in the first three calendar quarters (August–December 2010) and who were eligible for training and testing completed the training program. During that early time period, the carriers generally called back promptly and made quick commitments for scheduling training. All of the carriers during this period made their scheduled appointments for training and their mock audits.
- 44 percent of the eligible new entrants declined to attend the training during the first three calendar quarters. The trainer believed that this group was largely made up of previously-established larger carriers that were getting a new USDOT number for some reason and/or carriers that had been operating intrastate for a number of years and did not feel they needed the training just because they were beginning interstate operations.
- For the carriers that applied for an interstate USDOT number in the next 9 months, the average rate of those who agreed to participate in the training dropped to 34 percent.
- For the following three calendar quarters, an average of 24 percent of the eligible carriers that applied for an interstate USDOT number agreed to take the training.
- For the last three calendar quarters, 10 percent of the eligible carriers that applied for an interstate USDOT number agreed to take the training. The trend is clear.

The drop in the participation rate eventually became acutely obvious to the training staff. It became significantly more difficult to convince validated new entrants that it was worthwhile for them to schedule for training.

The trainer believes that there were several dominant perceptions that contributed to new entrants electing not to take the training and testing. The next four subsections explain those perceptions.

4.2.3.1 Perception 1: CSA Enforcement Not Relevant to New Entrants

As mentioned above, rollout of the CSA Program occurred around the same time that the second-generation training began. Initially, the majority of carriers had the perception that the new CSA Program would bring closer supervision and more aggressive enforcement. Many carriers became more aware of the regulatory requirements and more concerned about avoiding enforcement. As a result, during the initial portion of the second-generation training, new entrants were quite receptive to the training, as demonstrated by the more than 50 percent participation rate.

About 1 year after the kick-off of CSA (in June of 2011), it become apparent to the new entrants that just as before under the FMCSA predecessor to SMS (i.e., SafeStat), small carriers—which make up the vast majority of new entrants—are not inspected often enough for SMS to ever rank them on most BASICs. Thus, the new entrants came to realize that nothing had changed for them under CSA, so the perceived fear of being targeted for attention by the CSA Program dissolved, thus reducing motivation to complete the new entrant training.

4.2.3.2 Perception 2: Training Unnecessary for Passing the SA

Because of the concentration of new entrants in eastern Montana, and because the CSA rollout had delayed the completion of a large number of new entrant SAs, in October of 2011, Montana scheduled a large contingent of resources to focus on the backlog of eastern Montana new entrants that needed SAs. The State scheduled a strike force of workers to go to that area of the State to conduct 60–70 SAs over the course of several days in January of 2012.

The State called the carriers and made appointments to conduct the SAs. For this strike force, instead of the inspector visiting each carrier, carriers were instead instructed to bring their records to a designated conference room. Because the State had scheduled (very visibly) so many SAs in this region, new entrants began to have the perception that other enforcement resources might be dispatched to the area, as well. The combination created a dramatic increase in motivation for the new entrants that were scheduled to receive an SA to attend the free training before the audits, which were scheduled for mid-January, 2012.

Suddenly, for a definite group of new entrants, it was again a priority to follow up on the trainer's suggested areas of improvement (related to safety) or to make adjustments in an area where they had failed to meet some minimum requirement. It was apparent that a group of new entrant trainees pushed to complete their homework and mock audits in the October to December quarter of 2011 prior to their scheduled SAs in January of 2012. This small spike in completion of training is shown in Figure 3.

No Show Response

When the strike force began conducting SAs, everything went well for the first 2 days. Each new entrant showed up with the necessary materials at the correct scheduled time. Then on the third day, a scheduled new entrant—without any warning of schedule conflict or attempt to reschedule—just failed to show for the appointment.

The normal protocol for no-shows is to try rescheduling them several more times. However, since this was a limited duration strike force utilizing human resources from other parts of the State, there was limited opportunity for rescheduling. Thus, the inspector entered the date of the no-show into MCMIS, which started a 10-day process that would ultimately end in rescission of that new entrant's USDOT number if the new entrant did not respond. As an implementation of 49 CFR 385.337, unless rescinded (turned off), this entry in MCMIS causes an automatically-generated letter to be sent to the new entrant, notifying them that their USDOT number will be inactivated on the 11th day after the no-show, unless they contact the State, provide an acceptable reason for the no-show, and promise to reschedule and show for that date.

According to the State inspector that made this entry in MCMIS, he called the phone number listed for that carrier and left a voicemail message stating that he had started the clock for inactivating the interstate USDOT number and that the carrier needed to reschedule with him immediately. Instead of contacting the State inspector and rescheduling the SA, that new entrant called the Montana FMCSA Division Office.

The Federal employee who received this phone call handled everything verbally and deemed the phone call from the carrier a sufficient response, thus stopping the 10-day clock for inactivating the carrier-dainterstate USDOT number. While the Federal employee's response was entirely legal, the normal practice was not followed in this case. FMCSA guidance is that the FMCSA Division Offices should refer the new entrant back to the State for the State to handle the matter. Further, the guidance states that in order to avoid suspension of their USDOT number, the no-show must provide a response in writing, and that response should demonstrate a willingness to complete the SA. The State inspector commonly will require that the no-show new entrant reschedule as soon as possible.

While the carrier apparently promised to reschedule their SA during this phone call, data in MCMIS shows that the carrier did not actually complete their SA until May 14, 2012—4 months after failing to appear. This had an immediate perception impact on the other new entrant carriers, essentially leading them to believe that were no adverse consequences for not showing up for the scheduled SA or for not promptly completing the SA.

SA Policy Changes

The trainer believes that policy changes, which made the SA easier to pass had a significant impact on new entrants' perceptions of the value of training. While the policy changes reduced the backlog of SAs and reduced the number of CAPs submitted to the Service Center, the trainer believes there was a substantial consequence. Namely, the industry perception caused by the reduction in the thoroughness of the SA substantially lowered the perception of the importance of the SA.

Impact/Repercussions

A combination of the above-described actions had severe impact on the willingness of new entrants to participate in any training. The new entrant community interpreted these actions to mean that:

- SAs could be easily delayed, and perhaps avoided entirely. Even if a carrier failed to show up for a scheduled SA, they knew that it was simple to get the 10-day clock turned off and to reschedule the SA for a later (perhaps a far later) date.
- Passing the SA was no longer as difficult; in fact, it was hard to fail. Thus the incentive for new entrants to participate in the training was significantly diminished.

4.2.3.3 Perception 3: Bakken Oil and Shale Formation

As mentioned above, eastern Montana is part of the Bakken oil and shale formation that is also found in North Dakota, Saskatchewan, and Manitoba. The level of oil-driven economic activity occurring there has been compared to a gold rush. The high pay available for supporting oil development in eastern Montana attracted a very high percentage of the new entrants to operate in the oil fields.

Just the physical distance and remoteness in eastern Montana may have affected attitudes about safety culture.

The motor carrier roadside enforcement effort depends on a physical presence. Because of the severe traffic congestion in the Bakken area, it was decided that carrying out enforcement at the fixed inspection station in that area was not possible. Further, the roads and traffic patterns in the area discourage mobile enforcement. It would be difficult—perhaps even impossible—to find a safe place to perform an inspection on these small roads that were being used far more than ever anticipated.

During the time of the second-generation training, the drivers for carriers working in the oilfields in eastern Montana were living together in dormitories, resulting in a very close-knit group. Thus, information about the lack of sufficient inspections to rank the new entrant's safety performance, the simplification of the SA, and the cavalier resetting of the 10-day clock to inactivate the interstate USDOT number was easily, rapidly, and widely communicated among the many new entrants in eastern Montana and beyond.

4.2.3.4 Note

It is possible that some portion of the drop-off in participation could be explained by the fact that in late 2011, the trainer stopped scheduling training sessions around Montana. That decision was made because the participation rate had dropped. It became cost prohibitive to travel to the far ends of Montana to provide training to increasingly smaller groups. However, the reduced level of training seems far more likely to be an effect rather than a cause.

4.3 LESSONS LEARNED

In spite of the substantial macro changes that took place in Montana from 2010 to 2012 (which ultimately undermined the enforcement pressures that originally encouraged adoption of a safety culture by first-generation trained new entrants), second-generation trained new entrants still exhibited a similar improvement in crash safety performance.

Lessons learned during the second-generation research demonstration include the following:

1. Even in the face of very negative macro influences, voluntary, free training and testing can improve trained new entrants' crash safety performance. This was true in comparison to both the Montana new entrants who declined the training and the control group new entrants from nearby States.
2. There is a clear limitation on what can be achieved uniformly in all States within their SA programs. States are operating on fixed Federal budgets (even as the number of new entrant applicants is increasing), and there are localized occasional economic booms (or other environmental factors) affecting the operating landscape in specific regions.
3. Perhaps the most important lesson learned is that unless the training and testing is mandatory, a substantial number of harder-to-convince new entrants will not participate (as shown in both the empirical data from this research and by diffusion theory). Many new entrant applicants will not be sufficiently motivated to take the training and testing seriously unless it is made mandatory.
4. It is critical, as part of implementing an initial training and testing program, to modify the existing SA to become a compliance verification process applied within 12 months after issuance of the USDOT number. New entrant carriers found to be noncompliant should be inactivated, or some other remedial action should be required.

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5. ANALYSIS OF SECOND-GENERATION RESULTS

5.1 GENERAL APPROACH

The analysis in this section is a comparison of the safety performance of new entrants who received training under the second-generation curriculum. As pointed out in the analysis of the first-generation curriculum, there are considerable differences between States in how they implement the MCSAP roadside enforcement program and what they choose to emphasize. In order to minimize the effects of that State-based variability, the second-generation curriculum was also applied in Montana for two reasons:

- In order to keep as many variables the same as possible from the first-generation training to maintain the greatest ability to compare the effectiveness of the second-generation curriculum; and
- To enable comparison of the very State-specific statistical approach used for the first-generation analysis with a more generalized statistical approach.

The general approach used for this analysis largely mimics the analysis performed for the 2005–06 training. However, there were a number of changes and improvements available due to:

- General data quality improvements in the intervening years (i.e., FMCSA has an ongoing data quality outreach program that monitors the success of States in meeting data quality and timeliness goals).
- Changes and additions to the data extracted from MCMIS and used in this analysis.

The changes and improvements are described in the following subsections.

Safety performance data for the new entrants who received the second-generation of training was collected from July 1, 2010 to August 25, 2013. While this provided data for a slightly shorter time window than what was analyzed for the first-generation trained carriers, it was deemed sufficient and was necessary in order to complete the analysis on time.

5.1.1 Active and Recently Active Carriers

FMCSA uses two different indicators for determining if a motor carrier is active: Recently Active and Active. Recently Active indicates that recent data for a motor carrier has been submitted to MCMIS or L&I. Recent MCMIS data could include a number of indicators that have been submitted within the last 3 years, such as inspection data, crash data, or an update of the carrier's MCS-150. By this last indicator (i.e., filing an MCS-150), all motor carriers who are in the New Entrant Program are considered recently active because they must file an MCS-150 to obtain authority to begin interstate operations. Recent L&I data could include submission by their insurance agent of a financial responsibility update via an MCS-90.

FMCSA also distinguishes between carriers that are considered Active and those that are considered Inactive. For-hire motor carriers are required to maintain minimum financial responsibility insurance. If their insurance agent discontinues that insurance at any time, the carrier is converted to Inactive status. Also as a result of enforcement actions, State and Federal personnel become aware of carriers that are no longer in business and mark them as Inactive. The data extract used for the 2005–06 analysis only included data for carriers that were considered Active.

However, the more complete data extract provided for analysis of the 2010–12 training included data on both Active and Inactive carriers (although there is some data that was not available, or not considered relevant, for Inactive carriers). Where relevant, the data for all carriers, regardless of status, is used.

5.1.2 Target Groups

In the initial analysis for the first-generation training, the original plan was to use two target groups: trained carriers and a control group (the selection process for the control group is explained earlier in Part I (A) of this report). That plan changed for a variety of reasons.

In the first-generation training, the trained carriers split themselves into two almost equally-sized groups: carriers that completed all of the training (including homework and the mock audit critique of it) and carriers that only completed the classroom training (but not the homework and mock audit critique). Therefore, the first-generation analysis plan described in Part I (A) was modified to include both target trained groups.

For the second-generation study, a fourth target group was identified: verified Montana interstate new entrant carriers who were offered the training but declined it. Those carriers also existed for the first-generation training, but definitive identification data for that group was not available for analysis.

During the validation process that was performed as part of the second-generation curriculum, 705 motor carriers indicated that they were: 1) only involved in intrastate operation, 2) that they intended but had not yet commenced interstate operations, or 3) that they had a long-term lease with another carrier. Because they were not operating as interstate carriers, or were not the safety-responsible entity, they were not eligible for the New Entrant Program and were not included in the group of carriers that declined the training.

Table 16 shows the original number of carriers and the number of carriers still active as of the August 2013 data snapshot in each of these target groups.

Table 16. Number of carriers in target groups for second-generation training analysis.

Group	Number of Carriers	Number of Active Carriers as of August 2013 Data Snapshot with Fewer than 15 Power Units	Percent with Fewer than 15 Power Units
Montana (Fully) Trained	204	170	83
Montana No-homework	39	26	67
Carriers that Declined Training	578	444	77
Control Group	11,561	8,375	72

As noted in 5.1.1 above, there is some data (such as power unit data) which is available only for active carriers. Where possible, this analysis would have used all carriers in a target group, regardless of whether the carriers were active. However, to preserve compatibility with the first-generation training analysis, the inactive carriers have been excluded.

Further, the first-generation 2005–2006 curriculum successfully convinced 52 percent of the trained new entrants to complete the homework. That meant there were almost as many no-homework carriers (102) as there were fully-trained carriers (117). There was enough data to draw independent conclusions about the no-homework carriers.

This was not true for the second-generation curriculum. As noted in Section 4.2, the second-generation research demonstration, the success rate of getting new entrants to schedule the training and then complete the homework and have it critiqued was dramatically higher than it was for the first-generation training overall.

The trainee completion rate for the second-generation curriculum was increased for the first three-quarters of a year at 87 percent, decreasing to 82 percent for the first full year. This was much greater than predicted. For the entire project, a total of 243 new entrant applicants entered training, and 204 of those completed the homework and had a mock audit. The no-homework group consisted of only 39 carriers.

As explained above, the motivation for second-generation trained new entrants to enter the training and complete the homework/mock audit was significantly undermined when the new entrants discovered that they were very unlikely to be targeted by CSA, regardless of their actions. Their motivation to enter the training was then further undermined when the new entrants came to perceive the SA as a required paper exercise that had no significant impact. This combination of undermining influences caused the participation rate to drop catastrophically. The completion rate for those that entered the training remained dramatically higher than for the first-generation training.

Originally there were 205 trained homework carriers. During a review of the incoming MCS-150 census data for these carriers, it was discovered that one carrier had a clear name mismatch with the current data in the MCMIS census file. The company's name was no longer the same. A review of both the original and current data for the carrier showed that the carrier had moved from Montana to North Dakota. Further, the original MCS-150 identified two titled officers and a safety officer. Two of these three original officers had been involved with the trainer in the training. The current MCS-150 also identified two titled officers and a safety officer. However, none of the original three officers were among the current officers. Management for the company had completely changed, indicating that the carrier had likely been sold. Therefore, the company was not included in the analysis of trained carriers, reducing the count of trained carriers to 204.

Thus, for the 2010–12 second-generation training and testing there were 204 fully trained carriers, of which 170 (83 percent) were still active as of the data cutoff. As shown in Table 16 above, for the 39 no-homework carriers, only 26 (or 67 percent) remained active as of the data cutoff. The small number of initial and surviving no-homework carriers meant that—for that subgroup—there was insufficient data from which any statistical conclusions could be drawn.

Thus, analysis for no-homework carriers in the 2010–12 second-generation training research is only marginally presented in this report.

5.2 DATA QUALITY AND CARRIER SIZE

In the first-generation training and testing, none of the trained new entrants had 15 or more power units. To maintain comparability, that maximum size was imposed as a filter for the size of carriers allowed in the control group.

In the second-generation training, there were several carriers in both the trained and declined groups that had considerably more than 15 trucks according to the current MCMIS census data. The trainers do not recall any trained carries having more than 15 power units at the time of training. However, in light of the oil boom business opportunities in eastern Montana and North Dakota, it is likely that a number of the carriers had grown in size. The issue is maintaining comparability between the first and second-generation trained groups.

While it is possible in the “oil-patch” environment that a new entrant carrier might have grown from less than 15 power units to more than 15 in a year or so, it does not seem likely that the carrier would have grown to 50 power units or more. Further, other research has shown that the more common presence of safety professionals on staff influences safety performance behavior for carriers with greater than 15 power units Since very small carriers very strongly dominate the New Entrant Program, and since FMCSA is researching the impact of training and testing on the safety performance of the majority of small new entrant motor carriers, the decision was made to exclude carriers with more than 15 power units from this analysis (to preserve compatibility with the first-generation analysis). As such, analysts could only use active carriers in the analysis, as they did not have power unit data for inactive new entrant carriers.

Table 17 is a revised version of Table 16. This version excludes data for carriers with 15 or more power units. It also excludes data for the no-homework carriers, since the group is too small to draw any statistical conclusions.

Table 17. Number of carriers in target groups for second-generation training analysis.

Group	Number of Carriers	Number of Active Carriers with Fewer than 15 Power Units
Montana (Fully) Trained	204	170
Carriers that Declined Training	578	444
Control Group	11,561	8,375

The data review/quality control for the 2005–06 first-generation training revealed that there were a number of carriers with an unreasonable ratio of power units to drivers in their MCMIS census data. For example, 1 carrier in the control group reported 30,000 power units and 1 driver. A plausible interpretation of that data is that that carrier had one truck that weighed 30,000 pounds. Another carrier reported 1,989 power units and 1 driver. This is probably the model year of the truck. Examples like these were excluded from the analysis groups.

Further, a review of MCS-150 data shows that the more recent census data appears much cleaner, with far fewer anomalies than there were during the timeframe of the first-generation analysis. Thus, fewer carriers had to be excluded because of data anomalies. Table 18 shows power unit groupings for the target groups in the second-generation analysis.

Table 18. Power unit groupings for the second-generation target groups.

Average Power Units	Declined	Trained	Control Group
1 Power Unit	286	87	4,822
2–4 Power Units	131	66	2,761
5–9 Power Units	23	16	595
10–14 Power Units	5	1	181
15–24 Power Units*	5	3	109
25–50 Power Units*	0	2	56
More than 50 Power Units*	0	0	18

* Excluded from further analysis

Table 18 uses the data for average power units from the August 25, 2013 MCMIS extract. Table 19 shows the percent of each fleet by power unit grouping.

Table 19. Percent of fleets in each power unit grouping (for each target group).

Percent of Fleets	Declined	Trained	Control Group
1 Power Unit	63.6%	49.7%	56.5%
2–4 Power Units	29.1%	37.7%	32.3%
5–9 Power Units	5.1%	9.1%	7.0%
10–14 Power Units	1.1%	0.6%	2.1%
15–24 Power Units*	1.1%	1.7%	1.3%
25–50 Power Units*	0.0%	1.1%	0.7%
More than 50 Power Units*	0.0%	0.0%	0.2%

* Excluded from further analysis

However, the homework carriers trained in the second generation were a bit larger than the carriers in the first generation of training. Table 20 shows that:

- In the first generation of training, almost 75 percent of the trained carriers had reported only one power unit. By the second generation of training, just over half of the carriers had one power unit.
- In the first generation of training, about one out of five carriers had two to four power units. By the second generation, almost two out of five carriers had two to four power units.
- The number of homework carriers that had five to nine power units was also greater in the second generation than it was in the first generation.

Table 20. Comparative size of homework carriers—count of carriers by power unit ranges.

Power Units in Each Group	Number of Homework Carriers, First Generation	Percent of First-Generation Homework Carriers with This Many Power Units	Number of Homework Carriers, Second Generation	Percent of Second-Generation Homework Carriers with This Many Power Units
1 Reported Power Unit	86	74.1%	87	51.5%
2–4 Reported Power Units	25	21.6%	66	39.0%
5–9 Power Units	4	3.4%	16	9.5%
Total	115	N/A	169	N/A

Table 21 provides a slightly different view of the carriers that received training. It looks at the total number of power units for each of the ranges of carriers. It shows that:

- In the first generation of training, the 75 percent of the carriers that were one-truck operations had almost half of the power units of all of the carriers trained. By the second generation, the half of the carriers that were one-truck operations had decreased to slightly less than 25 percent of the power units of all of the carriers trained.
- In the first generation of training, the carriers with five to nine power units had about 15 percent of the power units. In the second generation, the carriers with five to nine power units had increased to almost 30 percent of the power units.
- Further, within the group of carriers that had two to four power units:
  - In the first generation, 72 percent of the carriers had two power units, and 12 percent of the carriers had four power units.
  - In the second generation, 60 percent of the carriers had two power units, and 15 percent had four power units.

Table 21. Comparative size of homework carriers—count of power units by power unit ranges.

Power Units in Each Group	Power Units in the Group: First-Generation Homework Carriers	Percent Power Units for First-Generation Homework Carriers in This Group	Power Units in the Group: Second-Generation Homework Carriers	Percent Power Units for Second-Generation Homework Carriers in This Group
1 Reported Power Unit	86	49.7%	87	24.2%
2–4 Reported Power Units	60	34.7%	168	46.8%
5–9 Power Units	27	15.6%	104	29.0%

Clearly, while the new entrant carriers remained overwhelmingly very small carriers, the carriers that received the second-generation training were noticeably larger companies than the carriers that had received the first-generation training. This upward shift in new entrant size raised the concern that some of the larger carriers (excluded from this analysis) were not really new entrants and thus might have biased the results.

Nonetheless, all of the included carriers are small carriers. Less than 3 percent of the trained carriers and the carriers that declined training reported more than nine power units. About 4 percent of the control group carriers reported more than nine power units.

5.3 DATA ANALYSIS METHODOLOGY USED FOR THE SECOND-GENERATION NEW ENTRANT CURRICULUM

The methodology approach that was used for analyzing the results of the first-generation training is largely replicated for results of the second-generation training, with a few improvements. Any differences are explained in the following sections.

5.4 INSPECTIONS

This section presents data for various inspection measures comparing Montana homework new entrants, the small number of no-homework new entrants, carriers that declined the training, and control group new entrants for inspections performed from July 1, 2010 through the data snapshot cutoff date of August 25, 2013. It also presents some comparisons to the data from the 2005–06 study.

5.4.1 Differences in Number of Inspections per New Entrant

The averages presented in Table 22 are based on the total number of carriers in each target group.

Table 22. Inspection statistics for each second-generation target group with fewer than 15 power units—all carriers in target group.

Group	Count of Carriers	Count of Inspections	Average Number of Inspections per Carrier
Montana Fully Trained	170	634	3.7
Carriers that Declined Training	444	1,058	2.4
Control Group	8,375	39,132	4.7

Table 23 shows the same basic inspection statistics for each of the target groups, but the averages are based only on the number of carriers that received at least one inspection.

Table 23. Inspection statistics for each second-generation target group with fewer than 15 power units—carriers that had inspections.

Group	Count of Inspected Carriers	Count of Inspections	Average Number of Inspections per Inspected Carrier
Montana Fully Trained	127	634	5.0
Carriers that Declined Training	278	1,058	3.8
Control Group	5,881	39,132	6.7

For reference, Table 24 below repeats Table 2 from Section 3.1 above, providing similar inspection statistics for each target group from the 2005–06 training.

Table 24. Inspection statistics for each first-generation target group.

Group	Number of Carriers	Number of Inspections	Average Number of Inspections Per Carrier	Percentage/Number of Subgroup That Received Inspections	Average Number of Inspections per Inspected Carrier
Montana Homework	117	1,140	9.7	91% (107 out of 117)	10.6
Montana No-Homework	104	665	6.4	78% (81 out of 104)	8.2
Control Group	6,434	47,775	7.4	75% (4,806 out of 6,434)	9.9

The differences between the first and second-generation inspection statistics are startling.

- Critically, despite there being 45 percent <u>more</u> homework carriers in the 2010–12 trained group than there were in the 2005–06 group, the second-generation carriers received 44 percent <u>fewer</u> total inspections.
- While the second-generation control group was also somewhat larger than the first-generation control group, they received 18 percent fewer inspections. This may be partially due to the fact that the data collection period was 4 months shorter for the second-generation analysis.
- Assuming the shorter data collection period explains the 18 percent decrease in inspections for the second-generation control group carriers, there remains an additional 26 percent decrease in the number of inspections for the trained carriers that is unexplained (because, as explained above, the second-generation carriers in general reported 44 percent fewer total inspections).
- Thus, of the surviving 170 new entrants in the 2010–12 group of trained new entrants, only 127 received any inspection, or 74 percent. This is in contrast with the 91 percent from the first-generation analysis that received an inspection.
- In the 2005–06 first-generation study, the homework carriers accumulated far more inspections per carrier than did the control group. In the 2010–12 portion of the study, the homework carriers still had more inspections per carrier, but the average number of State inspections was dramatically decreased. Possible explanations for this could be:
  – A reduction in enforcement rates in Montana, as compared to enforcement rates in neighboring States.
- Suspension of roadside inspections in the oil patch regions of the State. As discussed earlier, congestion in the eastern part of Montana, where many of the new entrants were concentrated because of the oil fields work, made it impossible for enforcement officials to conduct roadside inspections in that part of the State. This may be the reason why the

total number of inspections performed by Montana on new entrants was down, even though the total number performed by the State for all carriers was about the same. .

These make the likelihood of seeing any significant findings for the second-generation trained new entrants far less likely. However, analysts observed the same trends in safety performance for the second-generation homework group as they did for the first-generation homework group.

5.4.2 Differences in Number of Power Units

For analysis of the 2005–06 training, the only census data provided was for carriers that were currently active. As a result, the actual census data used for the trained carrier groups was an amalgam of the data from each carrier's new entrant year (see Table 25).

Table 25. Power units per carrier for each first-generation target group.

Group	Count of Carriers	Count of Power Units	Average Number of Power Units per Carrier
Montana Homework	117	190	1.6
Montana No-homework	104	191	1.8
Control Group	6,434	10,658	1.7

The available data for the 2010–12 training also allowed analysts to see both active and inactive carriers. However, MCMIS only retains power unit data on active carriers, thus the number of trained carriers with power unit data is smaller than the number of identified carriers (see Table 26).

Table 26. Power units per carrier for each second-generation target group, fewer than 15 power units.

Group	Count of Carriers	Count of Power Units	Average Number of Power Units per Carrier
Montana Homework	170	370	2.2
Carriers that Declined Training	444	815	1.8
Control Group	8,375	17,729	2.1

As an aside, from 2000 to 2010, the average number of reported power units for each new entrant carrier dropped continuously. FMCSA believes this is due to a continuous improvement in data quality. This is illustrated by the fact that the drop in the average number of reported power units per new entrant carrier for the 2010–12 analysis caused by removing carriers with invalid ratios of power units per driver (more than five power units per driver) was nowhere near as large as it was for the 2005–06 analysis.

For the second-generation analysis, there were 10 Montana new entrant applicants with fleets in excess of 15 power units. Five of these took the training. While they were not included in this analysis because of exceeding the cutoff level of 15 power units, a quick look at them clearly indicated they were much higher risk carriers. Without further analysis, the research team can only speculate that perhaps these carriers were high risk carriers that reincarnated as new entrants.

There is reported skepticism within FMCSA that applicants with 25–50 power units are truly new entrants. Thus, it is not clear whether the increase in number of reported power units for the 2010–12 group is a further demonstration of improved data quality or perhaps an operational shift, in which an increasing number of previously established carriers are applying as new entrants.

Thus, it is interesting to see that there was an increase in the average number of power units between the first- and second-generation analyses— a reversal of the trend observed from 2000 to 2010. In the second-generation control group and trained carrier groups, there were substantial increases in the average numbers of power units. Possible explanations include:

- Economic/other barriers to entry led to a decrease in the number of single-driver, single-vehicle carriers.
- As the CSA Program became more effective and carriers better understood how SMS BASIC scores were (and still are) created:
  - There became an incentive for carriers to report more quickly increases in the number of power units that they had.
  - There was an increased incentive for carriers to inflate their reported power unit counts slightly.
- It may also be that single-vehicle and other very small carriers are more likely to become inactive in MCMIS (perhaps by leasing onto a larger carrier), leaving only the larger active carriers in the current carrier table. That would not necessarily mean that those drivers and vehicles are not still operating. It could mean that their operational data is hidden because they have leased onto larger carriers and are operating under those carriers' authority.
- It could also be that more carriers—particularly larger ones—are reincarnating themselves to avoid being targeted by the more stringent CSA Program. If that is so, those carriers have poor safety cultures. This could be true for the 5 largest new entrants (with fewer than 15 power units) included in this analysis. One was clearly a reincarnation, while one was questionable. All five had worse safety performance than the rest of the trained new entrants, and they had more inspections with more violations.

5.4.3 Results on Inspection Measures

On a number of the inspection measures, the second-generation homework trained carriers did not improve as much as the first-generation of homework trained carriers. As explained elsewhere, the very poor performance of five relatively larger carriers contributed to this significantly, overwhelming the very good safety performance of the remaining very small carriers. The considerable decrease in the amount of accumulated safety performance data available for the second-generation evaluation also contributed to this. However, as explained below, even with these limitations, the homework new entrants still performed substantially better than any other group on the crash performance measure.

5.4.3.1 Background – Expected Rates

In the analysis of the first-generation trained carriers, it was noted that, as compared to national averages:

- A substantially smaller percentage of inspections for Montana homework carriers resulted in driver violations, vehicle violations, and vehicle out-of-service (OOS) orders.
- A substantially larger percentage of inspections for Montana homework carriers resulted in driver OOS orders.

Because such a large percentage of the inspections on the trained carriers occurred in Montana, the first-generation analysis made an adjustment to inspection measures to assure that any differences in performance measures were due to real differences in carrier performance, and not due to what State the carriers were inspected in. That adjustment took into account the difference between the overall rates in Montana and the national averages.

The second-generation analysis introduces a more refined concept for accomplishing this normalization of inspection measures between States. It takes into account the deviations of that new entrant from average by State for all inspections. Thus, there is a unique number of above- or below-average violations for that carrier in each State. In the first generation analysis there was a unique number just for Montana and a national average for all other States. Based on the number of inspections that the carrier received in each State, and overall results of all inspections (in each of the inspection performance measures) in each State, the overall expected value for each measure is calculated for each carrier (or for this analysis, group of carriers). That calculated actual performance is then compared to the expected performance. Thus, for each measure for each carrier, the carrier's performance in each State is compared to the average performance in the State for that measure.

So, for example, consider two carriers, both of which had 20 percent of their inspections result in vehicle OOS orders.

- The first carrier was inspected in States where, on average, 25 percent of all inspections resulted in vehicle OOS orders. The carrier's performance was 5 percent better than the expectation. This is a good result, indicating an above average carrier.
- The second carrier was inspected in States where, on average, 15 percent of all inspections resulted in vehicle OOS orders. The carrier's performance was 5 percent worse than the expectation. This is a poor result, indicating a below average carrier.

A more detailed explanation of how this methodology is applied is presented in Appendix E under the subtitle "Adjustment Calculation - Over or Under Expected Value."

5.4.3.2 Data Used

All analyzed second-generation inspections were conducted between July 1, 2010 and the August 25, 2013 data snapshot cutoff. The national baseline analysis was performed for all carriers in MCMIS. The difference analysis was performed for the inspections for the defined groups of carriers.

5.4.3.3 Performance of New Entrant Groups

Table 27 shows the over/under comparison rates for the second-generation control group of new entrants and the various Montana new entrant target groups. In this case, all measures for all groups exceeded what was expected.

Table 27. Comparison of target groups performance on inspection safety performance measures—carriers with fewer than 15 power units.

Carrier Group	Comparative Driver OOS Rate Over Expected	Comparative Vehicle OOS Rate Over Expected	Comparative Driver Violation Rate Over Expected	Comparative Vehicle Violation Rate Over Expected
New Entrant Trained Carriers (170)	1.81%	14.44%	12.38%	10.33%
Carriers That Declined Training (444)	2.26%	4.28%	6.95%	6.55%
Control Group (8,375)	3.28%	6.37%	7.74%	9.32%

5.4.3.4 Observations

Unlike with the 2005-06 training, the homework group of second-generation new entrant carriers did not perform as well as all carriers (overall) on any measure. Since the group of all motor carriers consists mostly of experienced carriers, this is an expected result, but differs from the 2005-06 homework result. However, there are two findings in this data that are statistically significant at the 95-percent level (but not at the more stringent 98-percent level dominantly used for the first-generation analysis).

For the second-generation trained (homework) carriers, significantly fewer driver inspections resulted in driver OOS orders than for the control group. This is not a surprise, given there is a high correlation between driver OOS rates and crashes, and the homework carriers also had better crash performance.

Conversely, more of the second generation homework carriers' vehicle inspections resulted in vehicle OOS orders than the control group. However, as explained above, this negative difference is entirely due to bad inspection data incurred by the five larger, very poorly performing carriers. This represents about 2.5 percent of the trained carriers who ended up being poor performing outliers. The research team is confident that one of those was a reincarnated carrier. This demonstrates the impact that a few outliers can have in a small data set.

The findings from the first-generation training were quite clear:

- The inspection performance of the trained carriers was significantly better than the inspection performance of the control group.
- The inspection performance of the trained carriers was so improved that it was not significantly different from the overall inspection performance of all carriers, with one exception. It was actually significantly better than the overall performance of all carriers in the percent of inspections resulting in vehicle OOS orders. Unfortunately, this measure has a low correlation with future crashes. In the second-generation training, the trained

carriers performed significantly better than the control group and the declined carriers on driver OOS orders. This measure is highly correlated with future crashes.

While there certainly appear to be numerous other factors in play between the first- and second-generation training, as described elsewhere in this document, it cannot be concluded that there was a statistically significant difference in safety performance on inspection data between the second-generation trained carriers and the control group. The significant difference in safety performance on crash data is discussed below.

5.4.4 Carriers' Drivers' Inspection Violation Measure

Another way to analyze inspection data is to use the "Carriers' Drivers' Inspection Violation" measure. This measure uses the same concept for analysis as the "Carriers' Drivers' Crash Rate," which is described in detail in Section 5.6.3. While this measure is somewhat different than other measures in common use, it is quite valuable for a variety of reasons, outlined below. (Note: this analysis matches the first-generation analysis and provides background for subsequent analyses.)

First, this analysis addresses the rate of violations per inspection, as well as the percent of inspections that resulted in violations. A large number of violations per inspection generally indicate that the inspector was concerned with the safety fitness of the truck and/or driver.

Second, this measure indicates the number of driver violations that occurred when the driver was working for the target group versus the number of driver violations that occurred when the driver was working for any motor carrier outside the target group. The number and level of violations that occurred while the driver was employed by the target group is especially valuable. This is because together they illustrate 1) whether the drivers tend to stay with that target group, 2) whether there is a difference in driver behavior when the driver is working for the target new entrant as opposed to when the driver is working for all other carriers, and 3) performance of the target group. This is a very clear measure of the influence of a new entrant carrier's safety culture on the behavior of its employed drivers.

Third, this analysis provides a view of how the carriers' drivers perform both overall and in comparison to their performance for the three target groups of new entrant carriers being studied.

Note: Previous separate analyses identified that a large percentage of the driver's license numbers reported to MCMIS were not validly formatted. Through the John A. Volpe National Transportation Systems Center, FMCSA instituted a program several years ago that attempts to correct formatting problems in driver's license numbers. For example, driver's license numbers in Maryland contain four dashes on the driver license document. While these dashes should not to be included in the MCMIS inspection data record, in many cases such additional separators were input with the data into a text field. The Volpe-instituted data cleaning program removes these dashes from the MCMIS "Updated Driver's License Number" field.

There still is no guarantee that the driver's license number in the "Updated Driver's License Number" field is validly formatted (i.e., that the licensing State will be able to return a driver history record when queried on the number). However, there are a number of cases where MCMIS contains matches (sometimes multiple matches) on incorrectly formatted driver's license numbers. For this reason, all (updated) license numbers were included in the analysis, not just validly formatted license numbers. Table 28 presents inspection measures for drivers' and carriers' drivers for second-generation carriers with fewer than 15 power units.

Table 28. Inspection measures for drivers and carriers' drivers (for second-generation carriers with fewer than 15 power units).

Measure	Trained Carriers	Carriers That Declined Training	Control Group
Drivers who had validly formatted DLN	330	485	15,291
Inspections for target carriers	634	1,058	39,132
Inspections for target carriers with drivers	614	999	38,489
Total violations in inspections for target carriers	1,172	2,066	84,496
Inspections with violations for target carriers	434	697	26,355
Total carriers' drivers' inspections (regardless of carrier)	971	1,518	71,178
Total violations in all carriers' drivers' inspections	1,797	2,834	148,859
Inspections with violations for all carriers' drivers' inspections	650	961	47,195
Target group percentage of inspections with violations	68%	66%	67%
Target group violations per inspection	1.85	1.95	2.16
Overall percent of inspections with violations (carriers' drivers' inspections with violations rate)	67%	63%	66%
Overall violations per inspection (carriers' drivers' violations per inspection rate)	1.85	1.87	2.09
Percent of inspections for target group	63%	66%	54%

There were not any substantial differences in the number of inspections with violations, or in the percent of violations that the drivers had with the target group carriers.

5.5 IMPLICATIONS FOR CARRIER SURVIVAL

One of the observations from the 2005–06 training was that many of the new entrants did not appear to have much knowledge about how to run a business. As a result, business training by the Montana Service Corps of Retired Executives (SCORE) was added to the second-generation curriculum. While there were delivery problems related to how thoroughly SCORE provided this training, data from the second-generation training results indicate that completion of the training led to a higher survival rate among the homework carriers than among any other group.

As noted above, data for all carriers (not just those that were active at the time of the data extract) was available for the second-generation analysis. This made it possible to measure the survival rate of carriers directly.

This is addressed directly in Figure 4. To allow a period of time when the new entrant might go out of business after starting operations, this analysis only included the carriers in the groups that had new entrant entry dates in 2010 and 2011. This includes 153 of the 204 trained (homework) carriers, 255 of the 577 carriers that declined training, and 7,000 of the 11,561 control group carriers. These timelines allow at least a year and a half between the carriers' new entrant entry date and the data extract date to see a pattern of business failure.

Figure 4 shows the percentage of 2010 and 2011 new entrant carriers, in each group, that had become inactive as of:

- 100 days after their new entrant entry date.
- 200 days after their new entrant entry date.
- 300 days after their new entrant entry date.
- 400 days after their new entrant entry date.
- 500 days after their new entrant entry date.
- 600 days after their new entrant entry date.

The above intervals were selected because there are just over 600 days (603 days) between the end of December, 2011 and the data extract date. Thus, all of these carriers were in existence as of December 31, 2011, and had at least 600 days during which they might be marked as inactive.

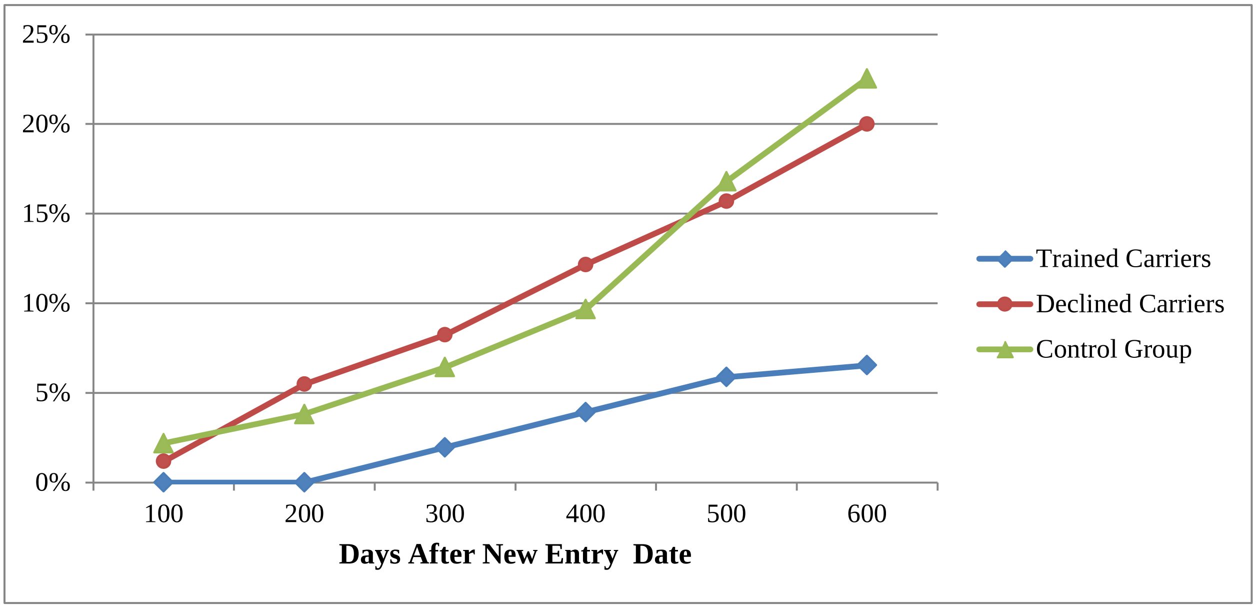

Figure 4. Line graph. Percent of carriers in each target group that became inactive, in days after the new entrant entry date.

5.5.1 Observations

The training appears to affect the survival rate clearly and positively by lowering the percentage of carriers that go out of business.

- As demonstrated by the MCMIS inactive date, the trained (homework) carriers went out of business at a statistically significantly slower rate than the control group carriers.

- The carriers that declined training went out of business at a rate that is statistically indistinguishable from the rate at which control group carriers went out of business.

Clearly, the training has a significant positive correlation with new entrant carrier business survival.

5.6 CRASH RESULTS

As was done with the first-generation training analysis, the project team analyzed crashes using both methods of exposure—carrier-centric and driver-centric. Refer to Section 3.2 for more details about these two methods.

5.6.1 Data Opportunities

The extended data provided in the August 2013 snapshot provided additional opportunities for analysis that were not available for the first-generation analysis. These additional opportunities are subtle and provide choices for reporting. The following discussion is provided as a tool for understanding these opportunities.

The MCMIS census table provides some information about both active and inactive carriers, including the new entrant entry date and the inactivation date. Table 29 compares a number of crash-related statistics for all of the carriers (including those that are inactive) in each target group to only the active carriers in each group.

Table 29. Selected data about target group and active target group carriers with fewer than 15 power units.

Measures	Trained Carriers		Declined Carriers		Control Group	
	All Carriers	Active Carriers	All Carriers	Active Carriers	All Carriers	Active Carriers
Total Carriers	204	170	578	444	11,561	8,375
Inspected Drivers	424	330	579	485	19,845	15,291
Crashes	30	25	28	26	1,064	797
Distinct Crashes*	30	25	28	26	1,058	792
Crashes with Drivers	29	27	27	26	1,056	789
Crashes with Inspected Drivers	20	18	18	18	716	563
Crashes with Uninspected (or Unidentified) Drivers	9	9	9	8	340	226

* There were a few crashes where more than one control group truck was in the crash.

Where possible, the analysis is performed using data for all carriers in a target group, both active and inactive. However, there is some data that does not make sense for inactive carriers. For example, there is no data for current power units for inactive carriers, since it is assumed the inactive carrier no longer has operational power units. Thus, when this data is part of an analysis (such as a crash rate calculated as crashes per power unit), only active carrier data can be used.

5.6.2 Crashes per Power Unit

The crash rate analysis considers all carrier crashes between July 1, 2010 and the August 25, 2013 data cutoff. Thus, the crash rates are expressed in crashes per power unit over the referenced timeframe. Because power unit data is only available for active carriers, the following table shows only active carriers' crashes. It does not include crash or power unit data for carriers that were originally in these target groups but later became inactive. Table 30 shows the crash rates, in crashes per power unit, for the trained carriers, declined carriers, and the control group.

Table 30. Comparative crash rates for target groups—fewer than 15 power units, valid ratios.

Crashes/Power Units	Trained Carriers	Declined Carriers	Control Group
Carrier Crashes	24	26	794
Power Units	364	808	17,563
Crashes per Power Unit	0.066	0.032	0.045

For this more traditional carrier-centric measure of crash rates, the crash rate of the trained carriers is higher than—but not statistically significantly different from—the crash rate of the control group. It is important to note that one of the trained carriers had three crashes, and four others had two crashes each. Such poor safety performance statistics are outliers for most truly small new entrants. These statistics further contribute to speculation that these five carriers, representing about 2.5 percent of the trained new entrants, were reincarnated high-risk carriers. These high crash rates for the outlying carriers contrast with the following analysis where none of the drivers associated with the trained carriers had more than one crash, whereas drivers associated with the declined and control group carriers did.

5.6.3 Carriers' Drivers' Crash Rate

This section presents results of applying what the authors believe is a far more powerful and discriminating driver-centric exposure for evaluating crash rate risk. This measure is described in detail in Appendix F under the subtitle "Carriers' Drivers' Crash Rate."

5.6.3.1 Exclusion of Crashes Connections

Again, as was the case in the analysis for the first-generation curriculum and for the same reasons explained above, only inspection connections were used for the second-generation analysis.

5.6.3.2 Results—Carriers' Drivers' Crash Rate

Table 31 shows carriers' drivers' crash rate calculations for carriers' drivers, using only the crash associations established via crashes that included inspection data. Again, the date range for including crashes was July 1, 2010 through August 25, 2013.

Table 31. Carriers' drivers' crash rates (for carriers with fewer than 15 power units)

Measure	Trained Carriers	Declined Carriers	Control Group
Inspected Drivers	330	485	15,921
Crashes	25	26	797
Distinct Crashes	25	26	792
Crashes with Drivers	25	25	789
Carrier Crashes with Inspected Drivers	18	18	563
Carrier Crashes with Uninspected (or Unidentified) Drivers	7	7	226
Carriers’ Drivers’ Crashes	22	44	1,350
Average Crashes per Inspected Driver	0.067	0.091	0.085
Average Number of Crashes per Driver while Driving for the Target Group	0.055	0.037	0.035
Percent of Crashes while Driving for the Target Group	81.8%	40.9%	41.7%

According to this measure, the drivers associated with the control group and with the carriers that declined training had almost one-third more total crashes per driver than did the drivers associated with the trained carriers.

5.6.3.3 Carriers’ Drivers’ Crash Rate Details

This driver-centric metric (illustrated in Table 31 above) associates all crashes a driver has had with the carrier for which the driver was working at the time of each crash. Thus, the carriers’ drivers’ crash rate has an implied measure of exposure; each year, each driver is assigned the exposure of a driver year.

As mentioned earlier, this measure indicates the number of driver crashes that occurred when the driver was working for the target group versus the number of driver crashes that occurred when the driver was working for any motor carrier outside the target group. The number and level of crashes that occurred while the driver was employed by the target group is especially valuable. This is because together they illustrate 1) whether the drivers tend to stay with that target group, 2) whether there is a difference in driver behavior when the driver is working for the target new entrant as opposed to when the driver is working for all other carriers, and 3) performance of the target group. This is a very clear measure of the influence of a new entrant carrier’s safety culture on the behavior of its employed drivers.

Control Group

There were 15,921 drivers associated with control group new entrants (as shown by inspections of control group carriers that had fewer than 15 power units). Of these drivers, 1,235 were involved in a total of 1,350 reportable crashes during the study period. One driver had 4 crashes, 10 drivers had 3 crashes, 92 drivers had 2 crashes, and 1,132 drivers each had 1 crash. This amounts to an average of 0.085 crashes per control group driver during the study period.

Overall, control group new entrants’ drivers had 42 percent of their crashes when the driver was identified as driving for a control group new entrant and 58 percent of their crashes when driving for any carrier other than a control group new entrant.

Montana Trained Carriers

As shown by inspections, there were 330 drivers associated with trained new entrants with fewer than 15 power units. Of these, 22 drivers had a total of 22 crashes during the study period. No driver had more than one crash. This amounts to an average of 0.067 crashes per trained group driver. This is clearly and substantially better than the 0.085 crashes per driver for the control group. Thus, drivers associated with Montana homework new entrants had a carriers' drivers' crash rate that was almost 30 percent better than the drivers' crash rate for drivers associated with control group new entrants. However, due to the low number of drivers and crashes, this cannot be considered a statistically significant difference.

Overall, trained carriers' drivers had 82 percent of their crashes when the driver was identified as driving for the trained new entrant carrier. They had only 18 percent of their crashes while driving for any carrier other than the trained carrier. This is a dramatic indication—even more so than was found in the analysis of the first-generation training—that trained new entrants have substantially lower driver turnover. It supports the assertion made in the TRB Synthesis Report 14 that "safe" carriers produce, attract, and ***retain*** safe drivers.

Montana Declined Carriers

As shown by inspections, there were 485 drivers associated with carriers that declined training. Of these, 2 drivers had 3 crashes each, 2 drivers had 2 crashes each, and 34 drivers had 1 crash each, for a total of 44 crashes. This amounts to 0.091 crashes per declined carrier's driver, a figure slightly but not significantly higher than the crash rate for the control group carriers' drivers.

Overall, drivers for carriers that declined training had 41 percent of their crashes while driving for the carrier that declined training. They had 59 percent of their crashes while working for other carriers. This indicates that there is considerably more driver turnover among the declined new entrants and the control group.

Nationwide All Carriers Comparison

This is essentially a semi-surrogate for experienced motor carriers. There were 3,286,903 drivers that had inspections in the identified timeframe. These drivers had a total of 243,718 crashes. Overall, the drivers identified in inspections had an average of 0.074 crashes per driver (243,718 crashes for 3,286,903 drivers).

- As expected, the crash rate of 0.085 for control group new entrants' drivers is substantially and significantly higher than the national average of 0.074 crashes in the same time period. This appears to be consistent with the reason that the New Entrant Program was created (i.e., new entrants are less safe than experienced carriers).
  The carriers' drivers' crash rate for trained carriers (0.066) is less than the national rate. This is consistent with what the authors predicted should occur for carriers that received training. However, while the impact is positive, because of the small number of drivers and crashes involved, for the second-generation training it is not statistically significant.

5.6.3.4 Summary

The “Carriers’ Drivers’ Crash Rate” measure—which is based only on government reported data, (i.e., not including any self-reported data)—identified a notable (but not statistically significant) difference in the predicted direction between the performance of trained new entrants’ drivers as compared to the control group new entrants’ drivers.

5.6.4 Additional Comparative Statistics – Drivers with Multiple Crashes

This analysis addresses crashes for all carriers in the identified groups, not just active carriers. For this reason, there is no limit on the number of power units for the identified carriers.

During the analysis period, there were 19,845 drivers associated—through inspections—with the 11,561 control group new entrants. Of these, 1,552 drivers had a total of 1,692 crashes. This is made up of:

- 1,425 drivers who had a single crash.
- 115 drivers who had 2 crashes each.
- 11 drivers who had 3 crashes each.
- 1 driver who had 4 crashes.

Through inspections, 424 drivers were associated with the Montana trained new entrants. These drivers had a total of 28 crashes. Each of the 28 drivers had only one crash.

If the drivers associated with Montana trained new entrants had crashed at the same rate as drivers associated with the control group new entrants, then it would be predicted that 33.2 drivers would have had a total of 36.2 crashes. This would have been made up of 30.5 drivers who would have had single crashes, 4.9 drivers who would have had 2 crashes, and 0.8 drivers who would have had 3 or more crashes. As stated above, the drivers associated with Montana trained new entrants had a total of 28 crashes—8.2 crashes less than predicted, with no drivers having multiple crashes.

Due to the small numbers, this finding regarding the lack of multiple crashes is not statistically significant. However, it consistently demonstrates that the crash performance of the drivers associated with trained carriers was better than the crash performance of drivers associated with control group carriers.

There were 579 drivers associated with carriers that declined training. Of these, 40 drivers had 1 crash, 2 drivers had 2 crashes each, and 3 drivers had 3 crashes each. This is a total of 50 crashes. If the drivers associated with carriers that declined training had crashed at the same rate as drivers associated with the control group new entrants, then 41.6 drivers would have had a single crash, 3.4 drivers would have had 2 crashes, and 0.35 drivers would have had 3 or more crashes, for a total of 49.4 crashes. This difference (0.6 crashes) from the expected number is functionally indistinguishable from the actual crash results of the declined new entrant carriers.

5.7 SAFETY AUDIT RESULTS

5.7.1 Background

An important reason FMCSA undertook the original first-generation training of new entrants in Montana was to determine if it would lower the number of new entrants expected to fail the SA, because of the much stricter automatic failure requirements of the forthcoming final rule. For this reason, an analysis was performed on the projected Safety Audit (SA) pass rate (under the final rule) for trained new entrants. Results from that analysis showed that a statistically significant, larger percentage of the first-generation trained carriers would have passed the forthcoming stricter requirements.

For the second-generation training, although hazardous materials (HM) carriers were not excluded from the training, the majority of the trainees were not HM haulers. For those who were, none were transporting commodities that required a HMSP from FMCSA. Those HM carriers were only subject to the higher insurance requirement of $1 million for financial responsibility. Examples include 173.5, Agricultural Operations; 173.5a, Oil Field Service Vehicles; or 173.6, Materials of Trade. Thus, none of the trained Montana carriers were subject to the HMSP CR requirement. As a result, all of the trained carriers in this study institutionally were subject to receiving a SA within 18 months. Even still, these carriers were subject to the following analysis elimination criteria:

- Later trained new entrant carriers (in 2012) that had not received a SA as of the data snapshot cutoff were eliminated from the analysis.
- New entrant carriers that went out of business before they received a SA were eliminated from the analysis.
- The small percentage of HM carriers that were not required to obtain a HMSP but were still identified to receive a CR under the SMS criteria were also eliminated from the analysis. The breakdown is as follows:
  - All eight trained carriers that had a HM placard indicator of “yes” on their census records received SAs rather than CRs.
  - Of the 13 carriers that declined training and had a HM placard indicator of “yes” on their census records, 10 received SAs and 3 received CRs.
  - Of the 228 control group carriers that had a HM placard indicator of “yes” on their census records, 188 received SAs and 40 received CRs.

5.7.2 Summary SA Results

Table 32 shows that for the second-generation training, the successful SA pass results largely replicated those of the first-generation trained new entrants. The table shows the percent of carriers that failed SAs, by year, for each of the target groups. It also shows the national averages for failure in each year.

Table 32. Percent of second-generation carriers that failed safety audits, by target group and year.

Year	Trained Carriers	Declined Carriers	Control Group	National Average
2011	**5.6%**	34.3%	39.2%	32.1%
2012	**3.6%**	15.0%	25.2%	24.4%
2013	**3.3%**	9.1%	17.1%	19.5%

The performance of the trained carriers is substantially and statistically significantly better than the performance of the control group. Performance of the Montana carriers that declined training is also somewhat better than that of the control group and of the national average.

Further, there is an operational measure of the effectiveness of the training on the new entrants' readiness for the SA. Namely, at least some of the auditors in Montana reported that when they were scheduling the SA with the new entrant, they asked the carrier if they had received the training. If the carrier indicated they completed the training, the auditor scheduled a half an hour for the SA. If the carrier indicated that they had declined the training, the auditor scheduled a half-day for the SA.

5.7.3 Safety Audit Trends

Following implementation of the final rule in 2008, the number of carriers that failed their SAs was initially very high. FMCSA thus had difficulties handling the volume of resulting CAPs. Via policy changes, enforcement proactively found ways to reduce the number of carriers that failed SAs. The impact of these policy changes on the SA failure rate is demonstrated by a yearly decrease in the percent of carriers that failed their SAs. The decrease in SA failure rate is especially large among the declined new entrants in Montana. As discussed above, that change is thought to have markedly contributed to the substantial decline in the new entrants' desire to participate in the free training.

The 2008 published final rule contained a number of criteria that—if the carrier was not in compliance— would result in a failed. For example, if the carrier did not have proof of annual vehicle inspections, or if the carrier did not have a drug and alcohol testing program as of the time they began operations, the carrier failed the SA. As a part of the effort to reduce the number of SA failures, the auditors have been working with the carriers by reinterpreting these requirements. Typically auditors now will give carriers a week to fix the problem, in order to avoid a SA failure. This creates extra work for the inspectors to verify that compliance issues were fixed. While this extra work by inspectors does not show in the data, the higher rate of compliance among the Montana trained carriers (versus the declined and control group new entrants) helps to reduce the burden for inspectors who have to work with carriers to avoid SA failures.

There are real and tangible costs to the carriers, the States, and FMCSA whenever a carrier has the potential to fail or actually fails a SA, for example:

- The inspector has to do extra work with the new entrant to determine if the prompt correction by the carrier now meets the requirement to pass.

- If the new entrant fails, then they are required to develop and provide a CAP to the regional FMCSA Service Center responsible for that State.
- Employees at FMCSA Service Centers are responsible for reviewing each CAP and determining if it is sufficient for not rescinding the new entrant's USDOT number.
- The new entrant carrier must implement the CAP.
- FMCSA staff in the new entrant's State (or the State MCSAP staff) must monitor and verify continuing compliance with the CAP (although there are insufficient resources to ensure this).
- If the new entrant does not provide an acceptable CAP, or if the new entrant is subsequently found not to be in compliance with the submitted CAP, FMCSA must rescind the new entrant's registration.

Reducing the SA failure rate up front reduces these costs for both new entrants and FMCSA. As the SA process continues to change, precise estimates for savings from reduction in SA failures cannot be projected.

As discussed earlier, as a result of these policy changes that were geared to reduce SA failures, the new entrants in Montana came to regard the current SA as a non-threatening paper exercise. What is unknown is whether FMCSA's resource limitation for reviewing CAPs led to a reduction in the intended safety benefits of the program as currently constituted.

5.7.4 Conclusions

In addition to the safety culture and safety performance benefits achieved by the second-generation training, it also is clear that the training and testing:

- Reduced the government's cost of performing the actual safety audits for the trained carriers.
- Reduced the cost of training (as compared to the first-generation), because classes included multiple carriers at once.
- Reduced the follow-up costs (for both the new entrants and FMCSA) that would have been associated with helping the carriers avoid a SA failure.
- Reduced the costs, to both the carriers and the government, associated with any SA failures and the associated CAPs.

5.8 CARRIER PERFORMANCE IN COMPLIANCE REVIEWS

The peer review committee for the second-generation research project expressed an interest in analyzing CRs to determine if any information could be gleaned from CRs performed on new entrants. As with the first-generation training, analysis of this measure for the second-generation training did not produce any clear results.

New entrant carriers are identified for CRs for varying reasons. Certain new entrants that transport HMSP commodities automatically receive a CR rather than a SA. Regular carriers are usually only flagged for a CR due to noticeably poor safety performance. Most other CRs are conducted because FMCSA received a complaint about a motor carrier or because of a motor carrier's safety performance data.

In general, very limited safety performance data is accumulated for many individual small motor carriers, which make up the majority of new entrants. Thus, other than for certain HMSP new entrants, a CR largely means that a carrier was targeted because of a crash, which is a rare event, relatively speaking. Thus, there are conflicting reasons as to why a new entrant would receive a CR.

Table 33 shows results for CRs for control group carriers, trained carriers, and new entrant carriers that declined training. This data is based on the carrier's final safety rating.

Table 33. Compliance review results, second-generation analysis.

Safety Rating	Trained Carriers	Trained Carriers Percent	Declined Carriers	Declined Carriers Percent	Control Group	Control Group Percent
Conditional	2	40%	2	18%	201	38.5%
Satisfactory	1	20%	2	18%	230	44.1%
Unsatisfactory	1	20%	1	9%	45	8.6%
Unrated/Null	1	20%	6	55%	46	8.8%
Total CRs	5	N/A	11	N/A	522	N/A
Total Carriers in this Group	204	N/A	578	N/A	11,561	N/A
Percent of Carriers who Received a CR	2.5%	N/A	1.9%	N/A	4.5%	N/A

The low frequency of CRs among new entrant carriers makes it impossible to provide any significant findings related to this data.

5.9 COMPLIANCE, SAFETY, ACCOUNTABILITY

CSA is an operational model, developed by FMCSA, which—among other things—ranks carrier safety performance using SMS. This analysis reviews SMS data (and supporting data) for the various target groups.

The CSA Program is built around BASIC scores, which are reflected in percentiles. These rankings are used to identify which carriers will receive some level of scrutiny (which could possibly lead to sanctions).

The following criteria are used to determining whether or not a carrier should be scrutinized:

1. Three or more BASIC scores above certain thresholds (with additional scrutiny if the carrier has four or more scores above the threshold).
2. One very high score (a BASIC score of 85 or above for the crash, HOS compliance, or unsafe driving BASICs) and one other score above the relevant threshold for that BASIC.

The intervention thresholds used are shown in Table 34.

Table 34. Intervention thresholds.

Intervention Threshold	Passenger	HM	General
Unsafe Driving, HOS Compliance, Crash Indicator	=50%	=60%	=65%
Driver Fitness, Controlled Substances/Alcohol, Vehicle Maintenance	=65%	=75%	=80%
HM Compliance	=80%	=80%	=80%

Source: FMCSA Web site, as of February 2014.

Additional scrutiny is also considered if a carrier has a high-risk flag for 2 consecutive months. However, since the data snapshot extract is for a single point in time, the necessary data for determining if a carrier had a high-risk flag for 2 consecutive months was not available.

There are also data restrictions on how many violations must have occurred for each BASIC (which determines whether that BASIC is calculated for a carrier). The minimum requirements are somewhat different from BASIC to BASIC. However, FMCSA found that the number of inspections required to calculate a BASIC makes little difference as to how many carriers get ranked, including for small carriers. For this analysis, the authors used 20 inspections in the last 24 months with violations by different BASICs, in order to determine which BASICs would be calculated. As shown in Table 35, only five of the trained carriers and seven of the declined carriers accumulated enough inspections with violations in BASICs for two BASIC scores to be calculated; two of the declined carriers also accumulated enough inspections for three BASIC scores to be calculated.

Table 35. Number of carriers with BASIC scores (with percentiles)for each target group.

Number of BASIC Scores (with Percentiles) for the Carriers	Trained Carriers	Declined Carriers	Control Group Carriers
One BASIC Score	11	17	628
Two BASIC Scores	5	5	336
Three BASIC Scores	0	2	102
Four BASIC Scores	0	0	32
Five BASIC Scores	0	0	8
Six BASIC Scores	0	0	1

Thus, relatively few of these second-generation new entrant carriers would have been identified for any form of scrutiny based on the SMS criteria.

1. Based on the first criterion listed above, only 27 of the control group carriers would have been identified for further scrutiny based on their SMS scores. Of these carriers, 1 carrier

had 5 scores (percentiles) above the threshold, 3 carriers had 4 scores above the threshold, and 23 carriers had 3 scores above the threshold. None of the Montana trained carriers or Montana declined carriers would have been identified for scrutiny.

2. Based on the second criterion listed above (i.e., one really bad BASIC above the 85th percentile and one other score above the relevant threshold), one of the declined carriers and none of the trained carriers would have been identified for scrutiny. However, 111 of the control group carriers would have been identified based on this criterion.

Overall, a total of 117 control group carriers, 1 carrier that declined training, and zero trained carriers would have been identified for scrutiny in SMS based on the above-described criteria. Only 117 control group carriers in total would have been identified because 21 of the 27 carriers identified by the first criterion (with 3 or 4 scores above the threshold) would have been included in the group of 111 carriers identified by the second criterion, thus creating an overlap.

If the control group were representative of the trained carriers, how many trained carriers would be expected to be identified by SMS for scrutiny? There are 2.1 percent as many trained Montana carriers as there are control group carriers. If trained carriers had been identified for scrutiny in SMS at the same rate as control group carriers, then an expected 2.5 carriers would have been identified for scrutiny.

As noted above, the issue of getting an SMS score calculated is based more on safety performance than it is on carrier size. Of the 117 control group new entrants that would have been identified for SMS, only 11 had 10 or more average power units.

The fact that no trained new entrant carriers would have been identified by SMS scores is a notable difference. But again, because of the small numbers and the level of difference in their SMS performance as compared to the control group, this finding is not statistically significant.

5.10 ADDITIONAL FINDINGS

Several additional analyses were completed, above and beyond those performed for the first-generation training. These additional analyses were performed in order to help understand the "on-the-ground" events (related to the oil and gas fracking boom) in Montana. Results from these additional analyses are presented to help define underlying environmental changes that impacted the second-generation research demonstration findings.

5.10.1 Inspection Counts Across Time

During the second-generation training and testing project, commercial motor vehicle activity increased dramatically in eastern Montana, making it impossible to conduct roadside inspections (or even weigh vehicles) because of the congestion.

Table 36 shows the number of inspections conducted in Montana from 2008–12. The data includes:

- Driver Inspections (Inspection Level 1, 2, or 3).

- Vehicle Inspections (Inspection Level 1, 2, or 5).
- Total Inspections.

Table 36. Montana inspection counts by type and year.

Inspection Year	Total Inspections	Driver Inspections	Vehicle Inspections
2008	39,768	39,181	21,058
2009	43,521	43,071	18,905
2010	37,825	37,401	15,351
2011	33,895	33,629	14,707
2012	37,166	36,975	16,167

There was a small—but not very substantial—increase in the number of inspections in 2012. The very small difference in the number of driver inspections and the number of total inspections shows that the number of Level 5 (terminal) inspections is relatively low. In 2012, nationally, about 2.9 percent of all inspections were Level 5 inspections. In Montana, in 2012, there were 191 Level 5 inspections. This is just 0.5% of all inspections.

Figure 5 shows the average number of inspections per carrier in Montana for the same time period. The number of inspections per carrier closely mimics the overall number of inspections shown in Table 36. This suggests that the lower number of inspections per carrier may be due to reduced total inspections performed in Montana as opposed to a larger number of new entrant carriers.

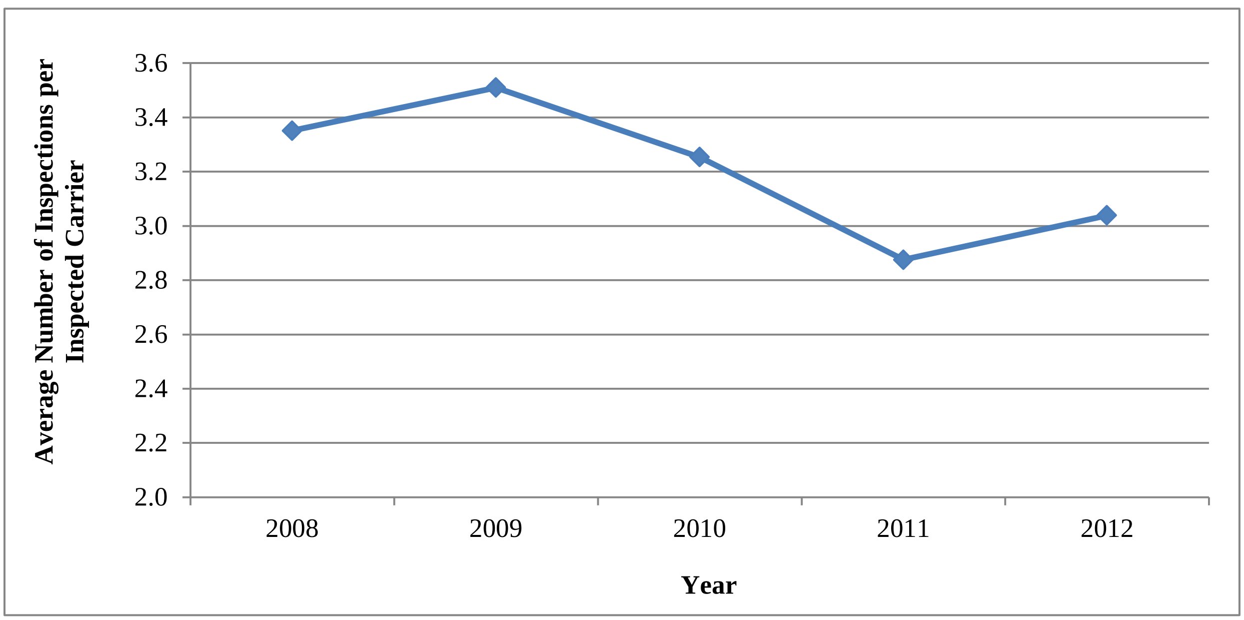

Figure 5. Line graph. Average number of inspections per inspected carrier in Montana, by year.

5.10.2 Changes in Results Across Time

The next four subsections analyze changes in results across time for the following measures:

- Driver OOS Rate.
- Vehicle OOS Rate.
- Driver Violation Rate.
- Vehicle Violation Rate.

For comparison, rates are provided for North Dakota (another oil patch State) and Colorado (a nearby non-oil patch State). National data is provided, as well. Because the figures use rates, it is reasonable to show the part-year rates for 2013, as well as full-year rates for 2008–12.

5.10.2.1 Driver Out-of-Service Rate

Figure 6 shows the changes in driver OOS rates for Montana, North Dakota, Colorado, and nationwide.

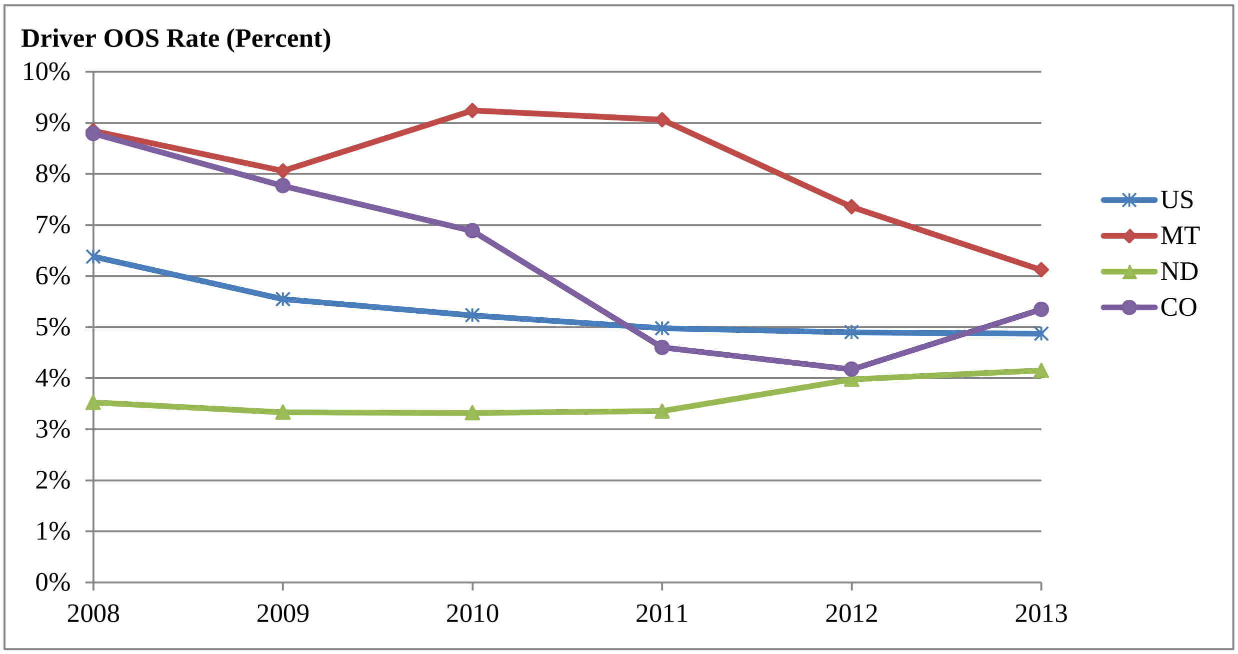

Figure 6. Line graph. Changes in driver OOS rates across time.

Nationwide, the driver OOS rate is trending downward, from 6.38 percent in 2008 to 4.90 percent in 2013. The driver OOS rate also dropped in Montana, from 8.84 percent in 2008 to 6.12 percent in 2013, but it still remains well above the national level. The Montana driver OOS rates for 2010 and 2011 exceeded 9 percent. In comparison, the driver OOS rate in North Dakota (another oil patch State) rose from 3.52 percent in 2008 to 4.15 percent in 2013, while in Colorado (a non-oil patch State) it dropped from 8.79 percent in 2008 (well above the national average) to 5.35 percent in 2013. The driver OOS rate for Colorado was well below the national average in 2011 and 2012.

5.10.2.2 Vehicle Out-of-Service Rate

Figure 7 shows vehicle OOS rates across time for Montana, North Dakota, Colorado, and nationwide.

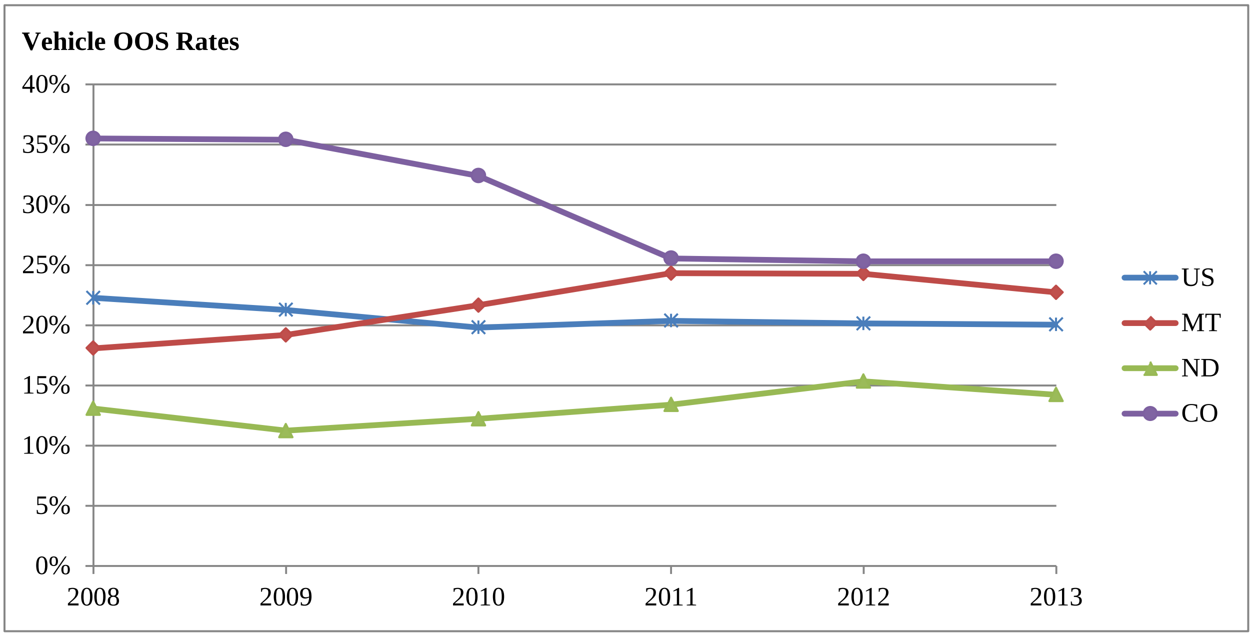

Figure 7. Line graph. Vehicle OOS rates across time.

Nationwide, the vehicle OOS rate is trending downward, from 22.9 percent in 2008 to 20.1 percent in 2013. The rate remained steady, around 20 percent, from 2010 forward. The vehicle OOS rate is trending upward in the oil patch States. It rose from 18.1 percent to 22.7 percent in Montana. It rose from 13.1 percent to 14.2 percent in North Dakota (peaking at 15.4 percent in 2012).

5.10.2.3 Driver Violation Rate

Figure 8 shows the changes in driver violation rates across time for the same three States, and for the United States as a whole.

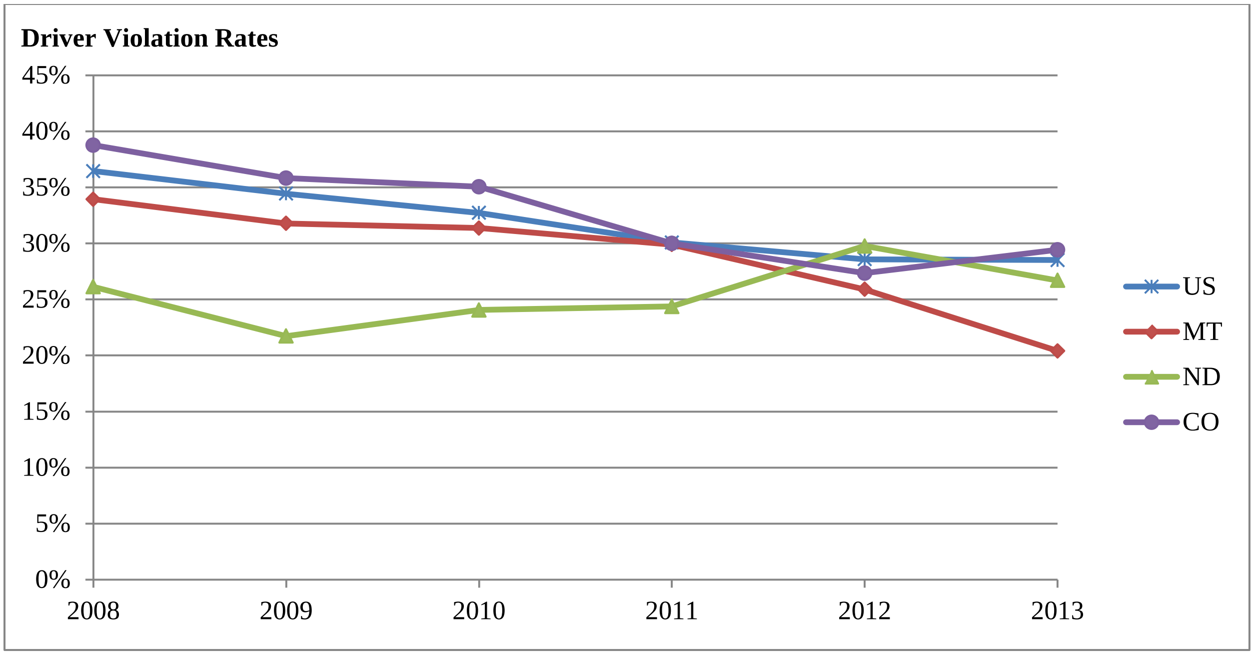

Figure 8. Line graph. Driver violation rates across time.

Montana driver violation rates are lower than the U.S. rate in each year reviewed. The rates are similar in 2011 (30.1 percent nationwide; 29.9 percent in Montana). In 2008, the driver violation rate in North Dakota started out well below the national average, at 26.1 percent (compared to 36.7 percent nationwide). However, by 2012 the driver violation rate in North Dakota was slightly above the national average (29.8 percent compared to 28.6 percent nationwide). The partial year data for 2013 shows that North Dakota's driver violation rate was just slightly lower than the national average (26.7 percent compared to 28.5 percent nationwide).

5.10.2.4 Vehicle Violation Rate

Figure 9 shows the changes in vehicle violation rates across time for the U.S. as a whole, and for Montana, North Dakota, and Colorado.

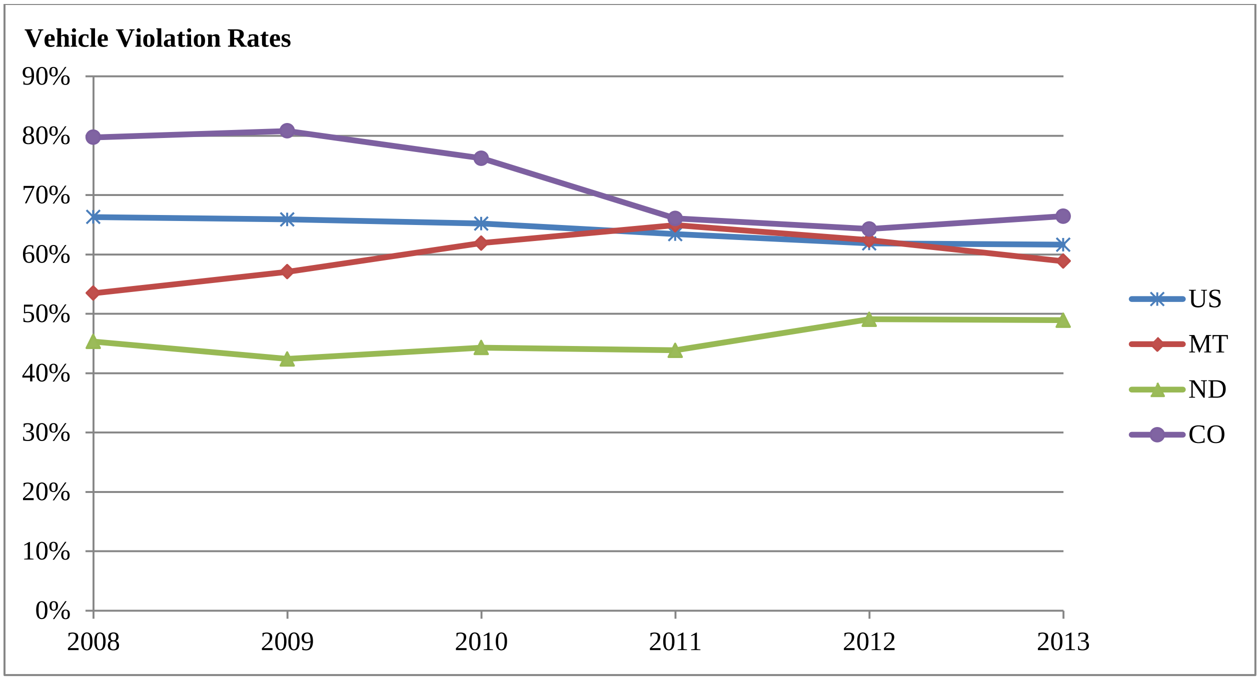

Figure 9. Line graph. Vehicle violation rates across time.

Again, nationwide, the vehicle violation rate is trending downward, from 66.3 percent in 2008 to 61.7 percent in 2013. In 2008, the percent of Montana's vehicle inspections resulting in vehicle violations was well below the national average (53.5 percent as compared to 66.3 percent nationwide). By 2012, Montana's rate was actually higher than the national average (62.4 percent as compared to 61.9 percent nationwide). The partial year data for 2013 shows that Montana's vehicle violation rate was down slightly—just below the national average, at 58.9 percent. While below the national average, the vehicle violation rate for North Dakota also trended upward, from 45.3 percent in 2008 to 49.1 percent in 2012 (and 48.9 percent in 2013, according to partial year data).

5.10.2.5 Summary

There appears to be a clear difference in the general trends in inspection safety performance measures for the two "oil patch" States, as compared to the national trends. The trends for the one selected non-oil patch State, Colorado, generally tracked the national trends.

In the two driver measures, there was little difference in patterns between Montana and the United States in general. However, North Dakota's rates in the driver measures started well below the national averages in 2008. North Dakota's driver OOS rate was just over half of the national rate in 2008. By 2013, while North Dakota's driver OOS rate was still below the national average, it had increased to over 85 percent of the national average. North Dakota's driver violation rate also started at about 70 percent of the national average in 2008. It was actually above the national average by 2012.

The patterns in the vehicle measures are even clearer:

- Montana’s vehicle OOS rate went from 81.2 percent of the national average in 2008 to 120.5 percent of the national average in 2012.
- Montana’s vehicle violation rate went from 80.6 percent of the national average in 2008 to 100.9 percent of the national average in 2012.
- North Dakota’s vehicle OOS rate went from 58.7 percent of the national average in 2008 to 76.2 percent of the national average in 2012.
- North Dakota’s vehicle violation rate went from 68.4 percent of the national average in 2008 to 79.3 percent of the national average in 2012.

5.10.3 Inspections Per Driver

Inspections are not random events. Inspectors select trucks for inspection based on some set of criteria. Some inspectors use the Inspection Selection System (ISS); some choose to look at trucks from carriers that they have not seen, or are not familiar with; and some are adept at selecting trucks that will have violations, especially those that will have vehicle violations.

An additional non-random reason for an inspection that is a somewhat common practice in a number of States is to screen vehicles and/or drivers before deciding to complete an inspection report (even the vehicles/drivers that have been selected for closer scrutiny), and if no obvious violations are detected, the vehicle and driver are released with no inspection report recorded or reported to MCMIS. Therefore, completed inspections (with data reported to MCMIS) generally indicate the presence of violations. The more inspections there are per carrier, the more it suggests poor underlying carrier safety performance and poor safety culture. The data demonstrate that the more often a carrier’s drivers/vehicles are selected for inspection, the higher the likelihood that carrier may have a future crash.

In Section 5.4.1, the authors examined the number of inspections per carrier. This subsection analyzes if the number of inspections per vehicle or per driver would provide any insight into the safety performance of the carriers. The analysis is based on a review of driver inspections associated with each target group. Only carriers with fewer than 15 power units were considered in this analysis. Summary data is presented in Table 37.

Table 37. Data related to inspections per driver for carriers with fewer than 15 power units.

Measures	Trained Carriers	Declined Carriers	Control Group
Carriers’ Inspections with Identified Drivers	614	999	38,489
Carriers’ Drivers	330	485	15,291
Average Number of Carrier Inspections per Inspected Driver	1.86	2.06	2.52
Average New Entrant Entry Date	6/28/2011	2/29/2012	10/20/2011
Average Months of Business	25.9	17.8	22.1
Average Carrier Inspections per Driver per Month	**0.0718**	0.1157	0.1137

The first observation was that—unlike the inspections per new entrant carrier group—the average number of inspections per inspected driver is lower for Montana trained carriers (1.86) than it is for Montana declined carriers (2.06). Both are substantially lower than the average number of inspections per driver for the control group drivers (2.52).

The question then arose, was there a difference in exposure? If inspectors differentially recognized the signs of safety culture on the trucks of trained carriers, it would seem their drivers should have received even fewer inspections than they did.

A review of the average number of inspections for each driver per month of operation shows that drivers from the Montana declined carriers and the control group received greater than 50 percent more inspections per month than did the drivers for the Montana fully-trained/homework carriers. It would appear that consistent with expectations of new entrants that adopted a safety culture, the inspectors showed preference and chose to perform and report inspections far more frequently, or at a higher rate, on trucks operated by the control group carriers and trucks operated by the Montana declined new entrants than they did for trucks operated by Montana trained carriers.

The following explains that because of the substantial change in attitudes for participating in the training, the study just had a substantially greater time exposure for fully-trained/homework new entrants to accumulate the larger number of inspections. The total number of inspections for homework carrier drivers presumably would have been even smaller if the drivers for the trained new entrants had had the comparably shorter exposure in which to accumulate inspections.

Section 4.2 examines this same issue from a different perspective.

5.10.3.1 Average New Entrant Entry Date

Anecdotal information provided to the trainers and visible changes in training participation rates over the project (see Figure 3) document that there were significant change in new entrant carriers' attitudes from the beginning to the end of the second-generation training project. As a group, the Montana new entrant carriers became less interested in receiving the training. Evidence of this is also found by looking at the significant differences in average new entrant entry dates in the three target groups. If all other things were equal and the participation rate was approximately even throughout the project, then it would be expected that the average new entrant entry dates of the three groups would be about the same. As **Error! Reference source not found.** shows, this was not the case. The average new entrant entry date for the trained carriers was 3 months earlier than the average new entrant entry date for the control group carriers. The average new entrant entry date for the carriers that declined training was 4 months later than the average new entrant entry date for the control group and 7 months later than the average new entrant entry date for the trained carriers.

These differences in average entry dates are consistent with the facts presented in Section 4.2.3, which documents that participation by fully-trained homework carriers was considerably front loaded. Thus the majority of the homework new entrants in the sample were from the early portion of the training. Reasons for why the change in attitudes occurred are explored in Section 6 below.

5.10.3.2 Conclusions from Additional Findings

For the second-generation training safety performance data, even though the trained carrier inspection total was higher for driving for the trained new entrant carriers, the per driver inspection rate per month was substantially and significantly lower than it was for the drivers of the control group carriers. In comparison, the drivers for the declined carriers had functionally the same number of inspections per month per driver as the control group. This clearly demonstrates that, regardless of the method inspectors are using to identify trucks (and drivers) for additional scrutiny, the second-generation trained carriers were targeted far less frequently. As noted earlier, the data show that the more frequently a carrier is inspected, the higher the probability that carrier had a poor safety culture and a higher risk of a future crash.

This additional analysis strongly supports the assertion that during the course of the training project, there was a change in attitude among Montana new entrant carriers for their willingness to participate. Looking at the 2010–12 time period, the average (mean) start date (June 28, 2011) for trained carriers with fewer than 15 power units was more than 8 months earlier than the average start date for the carriers that declined the training (February 29, 2012). Thus, the rate at which new entrants declined to participate in the training increased during the project, skewing that group's average start date to later. This is illustrated in Figure 3.

5.11 CONCLUSIONS

When performing analysis of results from the first-generation training , it was anticipated that the data would be so "thin" that it would not support statistically significant findings. However, the safety culture impacts of the training were so great that a number of statistically significant findings came from that analysis. Among those findings were:

- The inspection performance of the homework trained carriers was significantly better than the inspection performance of the control group carriers, and the same or better than the performance of the general population of carriers.
- The crash performance of the drivers for the homework trained carriers was significantly better than the crash performance of the control group drivers, and indistinguishable from the overall crash performance of all drivers for all carriers.
- If there had been SAs using the new pass/fail criteria, the homework trained carriers would have performed far better than the control group.
- There was also an indication that the training helped the carriers survive in business, but there was no data directly linked to this.

The findings from the second-generation training are similar to the earlier findings, in most respects.

- While it is true that on many of the inspection safety performance measures, the change in performance of homework trained carriers was similar to that from the first-generation training, because of the substantial change in attitudes toward training over the second-generation training project and the few larger outliers, the change in safety performance was not statistically significantly different from the performance of the control group.

- The trained carriers performed significantly better than the control group on one highly critical measure: percent of inspections resulting in driver OOS orders. This measure has a relatively strong correlation with future crashes. The trained carriers performed significantly worse on the percent of inspections resulting in vehicle OOS orders, which has a weak correlation with future crashes. The poorer performance on the vehicle OOS orders measure is also attributable to only five very poorly performing (somewhat larger) trained new entrant carriers.
- These five carriers represent just less than 2.5 percent of the trained new entrants, and one of them clearly was a reincarnated high-risk carrier. (Since freight carriers at the time of this study were not subject to screening or manual vetting, the authors can only speculate as to whether the other four might also have been reincarnations of unsafe carriers who reinvented themselves through the New Entrant Program.)
- The second-generation carriers' drivers' crash rate for drivers associated with homework trained carriers was 30 percent better than the crash rate for the drivers associated with the control group. It was even 11 percent better than the overall crash rate of all drivers nationally. However, because crashes are such rare events, because of the slightly shorter data accumulation period, and because of the just less than 2.5 percent outliers, there were not enough data to establish statistically significant findings related to the carriers' drivers' crash differences.
- The same data issue exists for crashes as it did for inspection data. Namely, the just under 2.5 percent of very badly performing, slightly larger carriers had multiple crashes each. One of these trained carriers had three crashes, and four others had two crashes each. (Four of these five outlying crash carriers also performed especially poorly on inspection violations.) Such poor safety performance statistics are outliers for most truly small new entrants, which further raises further speculation that all five of these poorly-performing new entrants were reincarnated high-risk carriers.
- Even so, the 30 percent difference between the crash rates of the trained carriers' drivers and the control group drivers would be considered statistically significant at a less rigorous level (90 percent) than was used for the second-generation analysis (95 percent). Thus, there is a clear and substantial difference in the crash performance of the drivers associated with the trained carriers as compared to the drivers associated with the control group carriers.
- As was found in the analysis of first-generation training and testing, the difference in SA performance is overwhelming.
  - The trained carriers did much better in their SAs, saving both the carriers and the government a substantial amount of money that would have otherwise been spent dealing with failed SAs and the resulting CAPs.
  - Further, the SA performance of the homework trained new entrant carriers was so markedly better than the performance of the untrained carriers that, on an ad hoc basis, some of the Montana auditing staff adjusted their audit schedules based on

whether or not a new entrant had completed the training. Untrained/declined carriers were allotted a half-day on the schedule. Trained carriers were allotted only a half-hour.

- As shown in Figure 4, the additional data available for the second-generation homework trained carriers quite clearly documents that far more of the trained carriers survived in business— at least for the completion of the new entrant period—than did untrained and control group carriers. Similar (but less dramatic) inferential results were seen in the first-generation analysis.
- As shown in Table 37, the driver inspection rate for control group carriers' drivers was 0.1137, while the driver inspection rate for homework carriers' drivers was 0.0718. Thus, drivers for the control group carriers received almost 60 percent more inspections per driver than the drivers for the trained carriers. This clearly demonstrates that drivers for the homework-trained group were inspected at a far lower rate than the drivers for the control and declined group carriers.

Finally, other findings—such as SMS performance and inspection frequency—also suggest that there is value in training new entrants in order to foster a safety culture and ultimately improve their safety performance.

PART II: DISCUSSION OF DIFFUSION THEORY AND OTHER SUGGESTED IMPROVEMENTS

6. DIFFUSION THEORY

6.1 WHAT IS THE THEORY?

Appendix C gives a detailed explanation of diffusion theory. This theory provides a structured presentation of why typical behaviors occur for different subgroups contained within a given population. In this case, the authors are applying the theory to the population of recent new entrants, examining the willingness of the new entrant subgroups to adopt a safety culture.

Diffusion theory describes five subgroups, each more resistant than the previous to adopting a safety culture. The most resistant subgroup, referred to as the laggards, likely includes some portion that will never adopt a safety culture. The now congressionally-mandated testing and other requirements to ensure such applicants understand applicable safety regulations will apply to applicants before becoming eligible to be issued an interstate USDOT number. That will, when implemented, raise the bar to entry, and it likely will prevent some of the more unfit carriers from being granted an interstate USDOT number. However, there will still be some unfit carriers that successfully obtain an interstate USDOT number. Focused enforcement efforts will still be necessary to identify and remove these carriers from operation.

The five subgroups discussed in diffusion theory consist of 1) the innovators, 2) the early adopters, 3) the early majority, 4) the late majority, and 5) the laggards. The innovators, the early adopters, and the early majority are typically the subgroups that are relatively quick to adopt a new idea or attitude. Conversely, the late majority is typically more resistant to adopting new ideas, and the laggards are very resistant. Thus, the latter two subgroups require further convincing or motivation before they will change their behaviors or attitudes. And some, particularly a portion of the laggards, are unlikely to adopt a safety culture, no matter what is done. Poor safety performance on their part will most likely have to be handled through enforcement.

Most very small motor carriers do not have safety professionals on staff. They have a higher tendency to share a common focus on operations, meaning they simply want to haul the freight and keep the trucks/buses rolling. The first-generation curriculum had a very weak incentive for the new entrants to participate, because prior to the final new entrant rule, which was effective February 17, 2009, almost no applicant failed the SA. Yet, results from application of the first-generation curriculum applied in 2005–06 demonstrated that about half of those new entrants who chose to participate in the training were successfully motivated enough (by that training) to engage in the performance test (i.e., performing the voluntary homework following the half-day of one-on-one training and having it reviewed via mock audit). This indicates that the other half of the trained new entrants, although they had voluntarily participated in the one-on-one training, were not sufficiently motivated by that form of training and/or external pressures to proceed with the above-described performance test.

In the true sense of diffusion theory, those who chose to participate in the training in any way are highly unlikely to be members of the last two subgroups (i.e., late majority or laggards). Thus, for this analysis, some assumptions are being made—namely, that those who elected to participate in the training are in the first three subgroups (i.e., the innovators, the early adopters, and the early majority).

The half of the trained new entrants that completed the homework during the first-generation research demonstration and had it critiqued thus can be categorized as likely being among the innovators and early adopters. Based on their safety performance data, these new entrants appear to have adopted a safety culture. The other half of the trained new entrants—those who did not complete the homework and have it critiqued—can be categorized as more likely being among the early majority. Based on their subsequent safety performance, they did not adopt a safety culture. The authors do not know what percentage of Montana new entrants declined the training because details of that data were not recorded, so the first-generation declined group cannot be discussed.

6.2 HOW DOES THIS THEORY EXPLAIN THE DIFFERENT RESULTS FOR THE SECOND-GENERATION TRAINING?

The second-generation curriculum initially started with a rather strong incentive for new entrants to participate, because the SA initially had been made more difficult to pass. Diffusion theory predicted there should have been a corresponding increase in willingness by new entrants to participate fully in the training. During the first full year of that training, it was observed that about 50 percent of those that were eligible for the training chose to participate. This implies that, according to diffusion theory, during the first year the early majority was also part of that group. Even more important, of those who elected to take the training, about 85 percent completed the homework and had it critiqued.

Thus, for the second-generation research demonstration, as predicted by diffusion theory, there were both a higher initial percentage that accepted the training as compared to the first-generation, and a higher percentage who completed the homework and had it reviewed as part of a mock audit. The completion of the homework/mock audit is a surrogate indicator that these new entrants likely adopted a safety culture. The data analysis in Section 5.11 corroborates this prediction (i.e., that there should be a corresponding increase in new entrants' willingness to participate fully in the second-generation training) actually occurred. That was partially in response to the many changes made for the second-generation curriculum, the more demanding SA requirements, and the enforcement environment at the beginning of the training project. The initial results were consistent with diffusion theory-based predictions that with additional incentives, more of the latter subgroups can be convinced to adopt a safety culture.

Based on the data, the second-generation curriculum—which offered more extensive training and group interaction—had a very positive impact on getting more of a latter subgroup to adopt a safety culture (while they were initially incentivized by the perceived threat of the new CSA program and the new entrant final rule). This was indicated by a dramatic increase in the percentage of new entrants that took the training and then voluntarily completed the assigned homework during the early portion of this research demonstration.

However, the second-generation curriculum was still voluntary. As such, it was vulnerable and was dramatically impacted by the following changes in external conditions:

- A boom in large-scale fracking operations in Montana and North Dakota meant very good paying jobs for almost anyone willing to live and work in that part of the State.
- New entrants figured out that the new CSA Program implemented at the same time as the training was not a new threat to them—i.e., it was no more effective for them (as small new entrants) than the old enforcement program.
- Policy reinterpretations related to SA pass/fail criteria meant that new entrants found it was difficult to fail the SA. Even if a new entrant did fail the SA, resources were readily available to quickly develop a CAP that would be approved. There is a cottage industry of providers that write CAPs for new entrants, and FMCSA does not have the resources to follow up effectively.

Thus, the supposedly stricter CSA Program ultimately became less effective incentivizing new entrants to take safety seriously, as new entrants discovered that very small carriers (which comprise most new entrants) do not receive enough inspections to be ranked by SMS. Montana new entrants came to perceive the SA as a non-threatening paper exercise. Details of how are provided in Section 4.2.3.2.

6.3 HOW DO THESE CHANGES RELATE TO THE FOUR BASIC ELEMENTS OF DIFFUSION THEORY?

6.3.1 Element One: What Is the Idea?

This element is composed of five sub-elements. They are:

6.3.1.1 Relative Advantage.

Perception of a relative advantage from taking the training was substantially undermined by:

- Finding out the CSA Program was not an increased threat.
- Changes in what is required to pass the SA made the training substantially less important.

6.3.1.2 Compatibility.

The latter bullet above strongly plays into the idea of needing to go to training when one can get by without training. It thus makes the idea of training incompatible with the perceived reality.

6.3.1.3 Complexity

The idea of needing to go to training makes the issue of getting by the SA more complex, another reason for not bothering.

6.3.1.4 Trialability.

One does not get the chance to try training to see if it is more effective. One either trains or does not train. So the opportunity to try something out first before deciding whether to adopt does not apply.

6.3.1.5 Observability.

Typically this would be observing others adopt the idea and seeing that they are doing better. Data from both the first- and second-generation research demonstrations provide illustrations of the positive impacts of training on safety and survivability. There was no effective mechanism for communicating that information to convince applicants it would be to their advantage to take the training. This is something that can be done if a program mandating training and testing is established.

6.3.2 Element Two: Communication

The method described under "Observability" above would be one way to achieve communication. However, it is the least effective of communication methods. The most effective is peer-to-peer word of mouth—information about the importance and value of training and testing being shared among those who are considering applying to become new entrant carriers.

6.3.3 Element Three: Length of Time

Length of time refers to the amount of time that is required from the initial idea (e.g., adopting a safety culture) being put forth to the point when each of the subgroups is convinced that the idea is worth embracing. There was little that these two research efforts could accomplish in building the story for purposes of these isolated projects. In the future, FMCSA is required to mount a program requiring mandatory training and testing. Within that context, the Agency will have the opportunity to conduct outreach and tell the story of how important training and testing is to business survival and safe operations.

6.3.4 Element Four: Social System.

Social systems are largely external factors. In the case of the second-generation training, the external social factors worked against the goal of convincing eligible new entrants that they should take the training. In the future, FMCSA should analyze the interconnectivity of its different programs in an effort to create a positive social environment for promoting other programs.

6.4 OTHER INSIGHTS FROM DIFFUSION THEORY

With the waning in participation, diffusion theory states that the most likely group to drop off first would be the early majority, followed by the early adopters. In the end, only the innovators participated in the second-generation project. Thus, although the initial external reasons influencing the new entrants to take the second-generation training waned (thus decreasing latter participation rates), it turns out that throughout the second-generation research demonstration, approximately 85 percent of those who elected to take the training went on to perform the assigned homework. So it appears that for those that were still convinced to enter the training, the second-generation curriculum was more successful in persuading the new entrants who ultimately decided to take the training to adopt a safety culture.

A valuable lesson learned from this experience—as identified by other voluntary projects and predicted by diffusion theory— is that when a certification or some other form of compulsory activity exists, better participation is achieved in all subgroups, including the more resistant subgroups (late adopters and laggards). This highlights the critical importance of FMCSA implementing the MAP-21 mandate for a proficiency test and whatever else is necessary to ensure understanding of the safety regulations. This report recommends that be implemented via the combination of training and testing.

It is the goal of the third-generation curriculum to explain why new entrants should want to adopt a safety culture and to reinforce the training material in order to achieve the MAP-21 goal of ensuring the applicant understands the safety requirements. Via implementation of the MAP-21 mandate, FMCSA will be better able to1) reach out to the more resistant subgroups, and 2) persuade them to adopt a safety culture. The latter goal can only be achieved if FMCSA adopts a mandatory requirement that applicant interstate new entrants must comply with before they are granted an interstate USDOT number.

If implemented as a way to meet the MAP-21 mandate, the third-generation curriculum (explained in Part III of this report) is predicted by diffusion theory to have considerably more influence over applicants in regard to adopting a safety culture. Thus, the approach recommended for the third-generation curriculum is based on this theory. In combination with the mandate for training and testing, it is predicted to be even more effective than the voluntary second-generation curriculum.

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7. OTHER POSSIBLE BENEFITS OF STANDARDIZED TRAINING AND TESTING FOR NEW ENTRANTS

7.1 WHO IS INCLUDED?

The mandate in the note to 49 U.S.C. 31144, as amended by MAP-21, requires:

> The Secretary shall initiate a rulemaking to establish minimum requirements for applicant motor carriers, including foreign motor carriers, seeking Federal interstate operating authority to ensure applicant carriers are knowledgeable about applicable Federal motor carrier safety standards.
>
> As part of that rulemaking, the Secretary shall establish a proficiency examination for applicant motor carriers as well as other requirements to ensure such applicants understand applicable safety regulations, commercial regulations, and provisions of subpart H of part 37 of title 49, Code of Federal Regulations, or successor regulations, before being granted operating authority (emphasis added).

Note: This requirement in Section 31144 is located under the motor carrier safety requirements, not under the motor carrier economic requirements. The safety section is the part of the U.S.C. that requires the New Entrant Program. Thus, FMCSA interpreted the term "operating authority," which is undefined in the safety part of the law, to mean all new entrants obtaining an interstate USDOT number. The data from both the first- and second-generation training and testing indicate the value and necessity of such mandatory training and testing for new entrants.

7.2 OTHER SYNERGIES

Because FMCSA is mandated to undertake such a program, there are a number of additional FMCSA program activities that could benefit from being integrated into the mandated training and testing program. Some examples of other possible program synergies are included below.

7.2.1 Removed New Entrants That Still Have Inappropriate Out-of-State Activity

Motor carriers currently apply for an interstate USDOT number, receive it, and are then placed on the list of new entrants. A number of these motor carriers are subsequently removed from the New Entrant Program for reasons other than successfully completing the SA and exiting/graduating to full status after 18 months. Reasons include:

- The carrier's application for a USDOT number erroneously indicated that the carrier would be a new entrant operating in interstate commerce. Upon contacting the carrier to validate the MCS-150 data, it is found the carrier made a mistake in filling out the MCS-150 and has no intent to operate interstate.

- The carrier's application for a USDOT number accurately indicates that it intends to begin operating interstate, but upon contacting the carrier to validate the MCS-150 data, it is found that the carrier has not yet done so. Dealing with this intent to begin interstate operations is discussed in more detail as a separate issue below.
- The carrier could not be contacted after three attempts to validate its descriptive census information.
- The carrier refuses to submit to the mandatory SA.
- The carrier fails both the SA and the CAP.

Some of the carriers who are removed from being current interstate new entrants by the validation process are subsequently encountered operating outside of their home State (e.g., by roadside inspections or crashes that occur outside the carrier's reported State of domicile).

The goal here is to enable FMCSA to better prevent such removed new entrant motor carriers from being able to continue operating interstate on the Nation's roads and highways. The issue is how to obtain more complete census data describing such carriers' operations (e.g., maybe they have divisions in more than one State operating under the same USDOT number).

All of the reasons above for removal or better data quality could be directly addressed if—in accordance with MCSIA Section 210(b) as amended—a prerequisite mandatory training and testing program were implemented, which required all new entrant owners/managers to successfully graduate before being issued an interstate USDOT number. Note: Intrastate motor carriers issued an intrastate USDOT number in Performance and Registration Information Systems Management (PRISM) States are not included in this requirement.

- Implementation of a training and testing requirement before issuance of the interstate USDOT number could also be used to ensure the accuracy of the interstate or intrastate designation. That in turn could then enable implementation of a more rigorous enforcement policy (based on the greater reliability of the data indicating intrastate only). A more rigorous enforcement policy could then be to issue an OOS order immediately for that driver/vehicle, i.e., do not let the driver and vehicle proceed when an intrastate carrier is inappropriately conducting out-of-State operations. This would require working with the Commercial Vehicle Safety Alliance (CVSA) to have this reason added as an OOS criterion.
- Even if the carrier did not provide sufficient or accurate contact data on its application for a USDOT number, it would no longer matter. That is because if the carrier wants to obtain its interstate USDOT number, it would have to complete the mandatory training and testing successfully. If it did not, then it would not graduate from the training or receive an interstate USDOT number. Thus, the carrier will be motivated to contact an authorized training facility to complete the mandatory training and testing, and that facility could then collect the missing data (or correct the incorrect data).
- To demonstrate its knowledge of safety regulations, Congress mandated that new entrants must pass tests prior to being allowed to graduate from the training. Those tests could incorporate the items now contained in the SA as part of completing the training process.

Thus, if a new entrant fails the SA during the training and testing, it would not receive an interstate USDOT number.

- Assuming the CAP process is built into the curriculum as a remedial action for those who fail the SA, failure to get an approved CAP would mean that the carrier would not be issued an interstate USDOT number.

7.2.2 "Intent" New Entrants

A number of motor carriers apply for an interstate USDOT number based on their intent to begin operating interstate. For a variety of reasons, many of these carriers do not begin operating interstate for indefinite periods of time after submitting the application. FMCSA's current interpretation is that because these carriers have not begun operating interstate, they are not eligible to enter the interstate New Entrant Program, and thus cannot be scheduled to receive a SA. However, their status in MCMIS may still indicate "interstate" for some period of time.

There is no institutionalized method for reliably determining when an intent carrier begins to operate interstate. One process is for the validation call center to try contacting an intent carrier to see if it has begun operating interstate. Alternatively, enforcement officials may identify intent carriers via out-of-State inspections or crashes. Neither of these processes ensures that all of the intent carriers who have begun to operate interstate are placed back into the system as interstate new entrants and scheduled for SAs.

Further, there is no way for a roadside inspector to determine whether or not an intent carrier has completed the SA process. MCMIS simply displays the carrier's operating status (e.g., interstate). In such cases, the driver is often allowed to continue the journey.

This does not create an incentive for such carriers to notify FMCSA when they begin interstate operations. This limitation could be addressed by implementing the proposed training and testing program that must be successfully completed before a carrier is issued an interstate USDOT number.

This would work because it would allow intent carriers to choose when to take the required training. They could declare that they are intending to operate interstate and complete the training. Then, because passage of the SA requirement could be built into the training, these motor carriers would be issued an interstate USDOT number and be authorized to begin interstate operations at any time they choose.

Such carriers could also wait to take the training and testing until later. However, they would not be able to accept any out-of-State load opportunities until they had successfully completed the training and received an interstate USDOT number.

The enforcement option could be the same as discussed in the inappropriate out-of-State operation section above. Namely, operating in interstate commerce without an interstate USDOT number could be cause for an immediate driver/vehicle OOS order. The combination of possibly missing interstate load opportunities and this more stringent enforcement approach would create more of an incentive for these motor carriers to obtain the interstate authorization in advance.

7.2.3 Reincarnated New Entrants

Currently, the vetting program is primarily focused on the subset of for-hire, interstate passenger and household goods carriers requesting a Motor Carrier (MC) number. However, those applicants are also applying for a USDOT number. This is true for three reasons. First, all new interstate motor carriers are required to obtain a USDOT number for operating. Second, it would be a giveaway for a carrier that is trying to reincarnate itself as a new for-hire motor carrier to continue using a previously-issued USDOT number. Third, in many cases, the reason the carrier is trying to reincarnate itself is for the purpose of getting a new USDOT number to hide its previous safety record.

FMCSA is building a capability to apply electronic risk-based screening to all applicants for a USDOT number. This includes refining internal review efforts for identifying carriers that are attempting to reincarnate. One tool developed earlier is the New Applicant Screening II (NAS II) software. The goal is to be able to raise a flag, and then the Agency can assign personnel to gather additional information from the proposed new applicant to determine whether it truly is a previously existing motor carrier. If such a determination is made, then the carrier's application for a new USDOT number, and possibly also for operating authority as a for-hire motor carrier, should be rejected.

FMCSA previously committed to giving this program higher visibility by reorganizing and grouping several related functions and elevating them to an office level under the Associate Administration for Research and Information Technology. The 2012 Government Accountability Office (GAO) report on FMCSA's reincarnated carriers program recommended that additional actions need to be taken. At that time, FMCSA was working on a rule for the Unified Registration System (URS) to integrate the aspects of the licensing and safety systems. The final rule was issued August 23, 2013, with compliance scheduled to begin on October 23, 2015. The risk-based screening program is being built to be part of that program rollout.

There is ongoing work for development of an application of electronic risk-based screening to all new applicants to identify higher risk applicants to whom vetting experts should be assigned—not just passenger carriers and household goods carriers, and not just for-hire. FMCSA has stated on record that the expansion of vetting to all high-risk applicants can only take place when sufficient resources become available. The method for obtaining these resources is planned to be via the rulemaking internally referred to as URS-II. It will incorporate specifications mandated in MAP-21 that are not included in the URS-I final rule, plus, as authorized by MAP-21, it will raise the price of the application fee to approximate the cost of running the vetting program.

The planned risk-based screening process could be assisted via the proposed prerequisite mandatory training and testing program. This is because a common practice when attempting to reincarnate is to use a variation on the data contained in the original application. It would be relatively straightforward as part of the proposal below to include validation as part of the overall training and testing process to verify all data about the applicant. This could routinely provide a better flow of information for all such carriers that would assist in the process of determining whether the applicant is a variation on an existing motor carrier.

7.2.4 Validating

A major product of FMCSA's contracted validation activity is the carrier's census data quality improvement. Although mentioned above, this function is addressed here as a separate issue to correspond with the fact that FMCSA operates this as a separate program activity.

One validation issue is that numerous new applicants that are applying to receive an interstate USDOT number are only operating intrastate. This occurs because their State requires them to obtain a USDOT number. This may be as part of the State's PRISM program activities. As part of making the application, the carrier incorrectly indicates on the MCS-150 form that it is engaged in interstate commerce. Thus, as part of the validation, the contractor verifies whether the applicant is an interstate carrier and other information (such as the number of power units and physical address). Chief Counsel for FMCSA approved that such corrected data obtained via the validation process can be updated in MCMIS census data.

This separate validation requirement could be incorporated in the mandatory training and testing. The initial contact—registering for the training and testing—could fulfill a substantial portion of this validation requirement and ensure that the descriptive data are updated in MCMIS. Assuming the training and testing program would be operated as a fee-for-service by third parties, the current expense to FMCSA of the validation contractor would no longer be necessary.

7.2.5 Data Quality

As noted above, the quality of the census carrier descriptive data in MCMIS has problems, largely stemming from the fact that it is self-reported by a large number of individuals. Some examples of problematic data categories include number of drivers, number of power units, whether an applicant needs a HMSP, and estimated vehicle miles traveled (VMT).

Inaccuracies in the first two categories cause SMS to be less accurate in ranking the safety performance of the carriers. Issues with the third category mean a significant number of carriers who do not need an HMSP are inappropriately indicating that they haul bulk quantities of HM. This automatically requires FMCSA staff to issue a temporary HMSP and it requires other staff—either FMCSA or MCSAP State—to conduct a CR. Then, during the CR, enforcement finds out that the carrier does not need an HMSP at all.

Lack of or inaccurate information on estimated VMT means that carriers that drive above-average miles do not benefit from having their SMS power unit equivalent adjusted to include their greater exposure. There are guidelines on estimating VMT that could be included as part of the training and testing of the new entrants.

This data quality problem could be addressed within the mandated training and testing program. It could be a prerequisite for graduation from the training and testing that new entrants verify and, if necessary, update their MCS-150 data.

Note. Previous FMCSA policy prohibited FMCSA from updating the MCS-150 (or MCS-150B) data furnished by a new entrant motor carrier. Namely, the MCS-150 data furnished by the applicant motor carrier was only allowed to be updated when that carrier submitted a new MCS-150 with updated data. A more recent policy allows updates of such data based on contacts such as SAs and CRs. It is proposed that such reviewing and verification of the carrier's MSC-150 (or MCS-150B) data could be completed as part of the training and testing process to ensure that accurate carrier contact and descriptive data become available in the MCMIS census data as part of granting the USDOT number, not subsequently as part of a SA or CR.

PART III: NEXT STEPS RELATED TO IMPLEMENTING A THIRD-GENERATION CURRICULUM

8. REASONS FOR DEVELOPING A BLENDED CURRICULUM THAT INCORPORATES E-LEARNING AND PEER DISCUSSION.

A safety culture is essentially a form of attitude. International learning theorist Robert Gagne defines attitude as “a mental state that predisposes a learner to choose to behave in a certain way.” He further says that successful training and testing to shape an attitude requires a dual focus: part on knowledge of the desired behavior—in this case knowledge of the safety regulations and basics of how to run a business—and part on application of methods to more directly encourage the learner to accept or believe. In this case, the goal is for new entrants to believe that compliance with the safety regulations is important to their business survival. Then, to successfully foster positive attitudes toward safety culture, it is crucial to lead new entrants to choose to perform safely.

8.1.1 Alternative Approaches

There are several training approaches that could be used to accomplish this goal, including in-person classroom training, electronic learning (e-learning) and/or a blended approach. The first and second-generation curricula employed different methods of classroom delivery. Thus far, there is no successful substitute for direct human interaction when working to shape attitudes, so switching to use of an exclusive e-learning training approach would not be as effective as continuing to include human interaction.

Although there have been some recent experiments with virtual human interaction (distance learning), the most effective method for promoting understanding and acceptance of a safety culture incorporates face-to-face mentors. Not only is virtual human technology less effective than face-to-face mentoring, but such technologies require high bandwidth and low latency of interaction. As a significant number of new entrants are located in rural or small communities where Internet access may be limited to less than broadband, the ultimate recommended curriculum will need to address such limitations.

Universities are increasingly using blended curricula of e-learning and face-to-face sessions and finding that it creates a more productive learning environment than e-learning alone.(7) The authors maintain that such a blended approach for the recommended new entrant training and testing would be more effective and efficient than an all-lecture approach (used in the first- and second-generation curricula) or an all-online approach.

The recommended approach would use a blend of supervised e-learning for knowledge of safety regulations, and live, onsite, mentor-led training discussions focused on attitude change and behavior modeling to promote understanding and to encourage adoption of a safety culture. Guidance materials will need to be predetermined and standardized for use by the discussion facilitators for the human interaction discussions.

8.1.2 Reasons for recommending a supervised e-learning portion

- The second-generation training demonstration conducted in Montana in 2010–12 encountered inquiries from a number of the new entrants as to whether they could send someone representing them (essentially as their agent) to take care of the safety materials on their behalf (i.e., either a third party they would hire, or someone who already works for the new entrant, such as a driver).
- Comments to the docket in response to the August 2009 advance notice of proposed rulemaking (ANPRM) on the knowledgeability requirement for new entrants expressed considerable concern that substitutes, such as the above, either never worked for the new entrant, or are more likely to leave the employment of the new entrant.(8) Thus, the impact of the training and testing would be lost and the continuity of the safety culture would be jeopardized.
- Supervision of the e-learning portion provides a convenient method for ensuring it is the owner/manager of the new entrant that is taking the training and testing. It allows for the collection and review of data that may assist in identifying possible reincarnation attempts and improving census data quality. It also allows the supervisor to support the trainee on an individualized basis, helping him or her work through details that may be difficult to understand or aiding those with lack of computer skills.

The first- and second-generation new entrant research training demonstrations conducted in Montana in 2005–06 and 2010–12, respectively, used traditional, instructor-led classroom training and performance testing. Both generations of the curricula included a detailed follow-up review of the assigned homework. Thus, the new entrant needed to physically prepare the recordkeeping files required for the SA and bring them in for a mock audit.

The second-generation curriculum used a group training session that included a longer, more-detailed presentation on the regulations. This group session thus had the advantage of peer interactions that helped reinforce the value of a safety culture. The 2010–12 curriculum also included a one-on-one session with a business mentor from SCORE. In addition to offering general business management advice, these SCORE mentors worked to reinforce the idea that operating safely and according to Federal standards is critical to business survival in the motor carrier industry.

Section 9 and Section 10 of this report describe how to revise the second-generation classroom curriculum to create a version that incorporates e-learning technologies that include knowledge testing as part of the training. Part of the success of e-learning comes from the ability of trainees to complete the instructional requirements at their own pace, and in some cases, in a learning style that suits their learning preference.

While the recommended homework in the first-generation training provided similar flexibility (i.e., trainees could work at their own pace), nearly half of the trained new entrants still chose not to undertake the additional effort and complete the mock audit performance test. Consequently, the question arises: what more might be included in the third-generation curriculum to better motivate the resistant new entrants to complete the homework? If successful completion of this curriculum is required to obtain an interstate USDOT number (per the MAP-21 mandate), then completion of the homework as part of the SA requirement would presumably became part of that mandate, thus incentivizing the applicant.

The first-generation training was flexible to the extent that it was a mutually scheduled, one-on-one session. The second-generation training was offered on a scheduled, rotating basis in different parts of the State. It initially had wide participation even though it was voluntary. It is recommended that if the third-generation curriculum is implemented nationally to meet the requirement of MAP-21: that it must be offered as frequent sessions, using a number of different providers in a wide variety of locations. This would significantly improve flexibility, and it would better address the 49 U.S.C. Section 31144(g)(2) requirement to consider the effects of this program on small businesses.

The specific approach proposed is for FMCSA to develop and test a blended curriculum that includes:

- Initial screening:
  - Data quality validation, including documentation that new entrants intend to operate interstate.
  - Screening to make sure new entrants do not appear high risk (i.e., that they may be attempting to reincarnate).
  - Preliminary knowledge testing for tailoring e-learning modules.
- Self-paced e-learning.
- More control of learning and methods of performance for new entrants.
- Built-in knowledge tests/quizzes throughout for assessment and reinforcement.
- Discussions on the importance of safety considerations in everyday operations in peer groups.
- Practical, active-learning homework involving preparation of the recordkeeping files required for the SA, followed by a critique of that homework via a “mock audit.”

This combination will ensure that training is not limited to knowledge acquisition and testing. The required homework will facilitate understanding of—and an ability to complete—the paperwork necessary to comply with FMCSA’s safety regulations. It will ultimately foster adoption of a safety culture for the new entrant’s daily operations.

The safety performance goal for new entrants is the same as it is for larger motor carriers with safety departments. Namely, reducing crashes and improving results of roadside inspections. The third-generation training curriculum will ensure that new entrant motor carriers understand the safety regulations as part of their daily operations before being granted a USDOT number.

8.1.3 Materials Already Available or in Development

To facilitate achievement of the safety goals outlined in 49 U.S.C. 31144(g), FMCSA produced various educational and training assistance materials. One of those is “A Motor Carrier’s Guide to Improving Highway Safety," which provides basic guidance on the FMCSRs, along with educational and technical assistance to the motor carrier community.

The restructured second-generation training curriculum developed and used for the 2010–12 research demonstration is available from FMCSA for use in developing the recommended third-generation curriculum. The subject matter expert personnel who developed and implemented that curriculum are available as resources.

There are technical reports describing two University of Central Florida (UCF) implementations of e-learning in blended curricula, developed in support of FMCSA MCSAP training: 1) Web-based Safety Inspector Training and Certification Program,[(9)] and 2) Web-based Safety Examiner Workforce Certification Test.[(10)]

Additionally, it was reported that FMCSA's National Training Center (NTC) is developing a multi-module, Web-based training course for new entrant motor carriers that is intended to be accessible via the FMCSA Web site.

9. BACKGROUND INFORMATION ON BLENDED CURRICULA

9.1 VALUE CONSIDERATIONS FOR A BLENDED CURRICULUM

There are situations where e-learning can provide additional value. It does this by building a strong, consistent foundation of knowledge among the students. As applied in a public health setting, it was determined that more engaging training methods (which required active participation by the trainees) led to greater knowledge acquisition, which ultimately led to reductions in accidents, illnesses, and injuries.[11]

Traditionally, e-learning courses allow students more flexibility in managing learning pace, provide test opportunities for evaluating knowledge retention, and provide practice (or simulations) for application of knowledge. Effective e-learning software engages the trainee more actively than videos or lectures. In-person peer discussions of information previously acquired via e-learning can subsequently involve the trainee even more personally in active learning. Thus, the combination of e-learning and peer discussions is more effective in changing behaviors and encouraging adoption of a safety culture.

A potential weakness of e-learning is that if the organization does not require and verify that students are indeed enrolled and participating in the training, there is no assurance that students will be motivated enough to engage in the process. There is also an issue related to who is actually taking the training and testing. Supervised e-learning will help to ensure that the supervisor knows who is taking the training and that it is an owner/manager of the new entrant company. It will also allow for up-front verification of data about the company and will help determine if that company qualifies as an interstate motor carrier and does not appear to be reincarnating.

Modern adult learning theory teaches that in a working world where adults are required to perform certain tasks and meet complex, regulatory mandates, training that allows the trainee to control the pace and work toward relevant and clear objectives has real value over traditional, instructor-led instruction. Thus, the safety performance goals will be better realized if the e-learning application is designed with the latest in adult-learning theory and performance-based methods and interactions.

However, e-learning cannot fully replace all aspects of traditional, face-to-face group environments, especially in situations where it is necessary to achieve changes in attitude (such as adopting a new attitude or culture about safety) or new ways of thinking. The shaping of attitudes and beliefs, or cultures, can be more effectively achieved via facilitated discussions among peers.

The establishment of both knowledge and development of shared perceptions and attitudes will be better achieved through a blended curriculum that includes both supervised e-learning and facilitated group discussions in a classroom setting that takes advantage of peer pressures. The following sections explore the pros and cons of e-learning, followed by two examples of successful blended curricula applied by other organizations.

9.1.1 Pros and Cons of e-Learning for New Entrant Knowledge Training

E-learning has many definitions. Essentially, it is learning that is supported through technology. This means e-learning may use the Internet, CDs or DVDs, computer-based activities, animations, blogs, discussions, and case studies. Well-designed, required, blended courses that include e-learning provide learning success rates measurably higher than those resulting from traditional, instructor-led, required classroom training.

Simple acquisition of knowledge and a passing proficiency test score do not ensure understanding or adoption of a safety culture or a safety assurance program. A blended training curriculum can provide opportunities for new entrants to apply learned knowledge by performing simulated job activities. Thus, this type of training can provide valuable reinforcement and performance-based measurement. Adult learners who need to understand how the training applies to the real world generally prefer such a blended, applied approach.

The proposed e-learning materials could remain available to students for later review or reference, following completion of the training modules. If that were done, then new entrants could review and refresh knowledge as needed, further assisting in achieving understanding and mastery of concepts.

The most manageable way to implement and provide incremental enhancements for multiple locations of the e-learning portion of a blended course is to provide all e-learning materials from a centralized location via broadband Internet access. This creates a requirement for sufficient bandwidth (both in and out of the central facility) and server processing capabilities to handle maximum demands for services.

While broadband service is not universally available in all locations in the United States, especially in rural areas west of the Mississippi River, it is generally available in most towns and cities (where this third-generation training and testing is recommended to be offered), specifically where there are public or private schools. If FMCSA determines that it would be valuable in the future to provide non-broadband services to new entrants in remote locations, the Agency can investigate the feasibility of using standalone CDs or DVDs for this purpose. However, there is great uncertainty as to whether such an approach could adequately address secure and valid recordkeeping for participants.

Effective learning has been shown to be an iterative process, with the best strategy including information presentation followed by application, practice, feedback (via testing), and if necessary, remediation (for each iteration or lesson). Only upon successful completion of a lesson should students be allowed to progress to the next course objective, again following the same sequence.

9.1.2 Overview of e-Learning

When considering the best way to implement and use e-learning as part of an educational strategy, it is important to define the major educational goal. For example, is the goal to improve students' understanding of concepts and key terms? Is it to improve their performance of specific job-related tasks? Is it to change the way students think about how they approach their daily tasks (i.e., the beliefs/culture of the organization)? Or is it some combination of these?

One also needs to consider the impacts of different age cohorts, learning styles, and comfort with electronic devices. These variables must be factored into the decision-making process and should be revisited periodically through curriculum development reviews to ensure that learning drives the outcomes.

9.1.2.1 Advantages

<u>Cost Savings</u>:

There are costs associated with developing and implementing any type of curriculum, whether it be in a traditional classroom format or via blended training and testing. However, there are substantial downstream cost savings that can be realized with the knowledge portion being based on e-learning. Because it is recommended that the curriculum be updated centrally and because an e-learning approach will require a smaller number of less specialized supervisors (i.e., there are no highly-skilled-in-regulations classroom instructors to train or add to the payroll), labor costs will be reduced by using this method. In this case it is proposed that there should be onsite supervisors, so the labor savings will be smaller than they would be in a pure e-learning application.

The e-learning approach further improves return on investment (ROI) because it spreads the fixed production costs for development of the e-learning curriculum and media and ongoing operation of a central facility over a number of users.

There would be additional savings through the following:

- Elimination of travel for supervisors and facilitators.
- Reduction in printed material.
- Elimination of the need to provide physical vehicles for the new entrant owners/managers to learn how they and/or their drivers must conduct vehicle inspections. Virtual vehicles will be used in the e-learning instead. (This training was not included in the first- and second-generation curricula.)
- Likely reduction in travel by applicants, since multiple training sites can be practical around the country.

In the physical world, any follow-up mock inspection would require a physical CMV and a parking area that would allow the applicant new entrant to perform the walk-around. For national implementation of this third-generation training and testing curriculum, it would be difficult to transport a defective vehicle safely from location to location. Thus, there would be a need to acquire additional vehicles. As a result, there would be variability in the training from site to site (different vehicles would have different defects) and there would be additional costs for maintaining the inventory of equipment.

However, if the walk-around is performed in a virtual environment, new entrants can focus their attention on as many different CMVs in as many settings as the trainer desires. Creation of virtual CMVs would allow the learner to practice without any of the associated setup, use, and clean-up costs. In addition, the trainees would be in control of the pace and could focus and review for as long as necessary.

Standardization:

Another benefit of e-learning is that it allows for much easier national standardization of the knowledge training curriculum. In traditional, instructor-led training, some teachers are more effective than others. Some teachers can become distracted by student questions and their own experiences. Although these side discussions can be valuable, they can detract from thorough and uniform coverage of all objectives. An e-learning approach would guarantee that the courses are presented consistently in each session, location, and with any e-learning supervisor. (E-learning can still provide for a wealth of side explorations if the applicant is interested.) Thus, e-learning software allows for the creation of a standardized process and consistency in the delivery of content, while still including opportunities for students at different levels to emphasize specific areas as needed.

Varied Learning Styles:

There are other benefits associated with e-learning beyond cost savings and standardized consistency in curriculum. For example, e-learning can cater to visual learners by providing graphics, animations, drawings, and multilevel presentations that can expand if the student is having trouble understanding the topic and wants more detail. E-learning can also cater to auditory and kinetic learners via stories, videos, audio clips, simulations, practice, and feedback. The provision of all these services creates the burden of ensuring sufficient server processing capabilities and bandwidth for adequate functionality.

Additional enhancements can be added incrementally to the training media as needed, incorporating relevant user feedback. A combination of peer tutoring (where trainees help each other via email or "chat" discussions) and "ask an expert" elements (in which a number of experts take turns fielding questions from trainees within a reasonably short time) can be used to assist trainees and help them work through difficult subject matter or issues that could benefit from group coordination or expert guidance. Students and/or experts can also highlight areas needing improvement in the curriculum in these types of forums.

Self-paced and Self-managed:

Knowledge acquisition can be enhanced through e-learning technology because learners can set their own pace.[12] It is difficult for a teacher to steer a classroom discussion so that it is tailored to all individual knowledge levels in the classroom. If discussions are too basic, fast learners become bored. If the discussion moves too fast, slower learners get left behind. On average, e-learning can compress delivery time for fast learners who can speed through the material, while allowing slower learners to work at their own pace to achieve mastery. Thus e-learning is more like a performance-based curriculum, rather than an hours-based curriculum.

In an instructor-led setting, students who don't understand the subject matter often become intimidated and do not like to ask questions in front of their peers. However, these quiet, shy, or confused students will ask questions through "ask-an-expert" online support and through other electronic technical help support that can be built into e-learning modules. Students typically are not hesitant to use built-in help capabilities with e-learning software. Using centrally-implemented software will allow for easy expansion of these built-in help capabilities as needs are identified during the demonstration/beta test and beyond, when the curriculum is fully operational. As the curriculum is utilized, a knowledge base of built-in help designed to address frequently asked questions can be developed and continually expanded upon. The proposed third-generation curriculum will provide the applicants with access to both supervised assistance and built-in help.

Collaboration and Teamwork:

In a tightly networked environment, e-learning courses can include tasks, projects, concepts, information, and built-in opportunities to chat, participate in discussions, and take tests, thus providing a sense of collaboration.

9.1.2.2 Disadvantages

In a 100-percent e-learning application, some learners feel isolated. For the unmotivated, this can lead to failure of the training. Although interaction can be built into an e-learning class, it does not provide the sense of community that comes with a group setting.(13)

Because of the variability in learning styles, there are people who do not respond well to media-based e-learning; they respond better to classroom interactions with a teacher.

Even when mandated, e-learning alone as a national standard is less likely to impact the significant subgroup of resistant learners identified by diffusion theory as the late majority. It definitely would not have any effect on the highly resistant laggards. Together, these two increasingly resistant subgroups account for 50 percent of the learning population of new entrants, and they require additional persuasion before they will adopt a new idea. In this case, the new idea is adopting the FMCSRs as a part of their daily operational practices. Simply posting mandatory e-learning resources on the Internet is very unlikely to succeed in convincing this half of the new entrants to adopt a safety culture, even if they successfully complete the training and testing.

Although it is not currently mandatory for new entrant training and testing, FMCSA's Education and Technical Assistance Program materials are posted and available for use on the FMCSA Web site. There is little evidence that those materials are widely accessed in their current form and voluntary environment. While the MAP-21 requirement to establish a mandatory training and testing program will help engage new entrant applicants, it will still be more difficult (with e-learning alone) to influence these motor carriers to adopt a safety culture or maintain a safety assurance program.

Exclusive e-learning lacks the natural collaborative peer sharing that can be achieved in a group discussion environment. That e-learning limitation can be somewhat ameliorated in high tech situations by use of shared tutoring through student message boards, chat discussions, email, teleconferencing, and various forms of virtual instructor involvement. Functionalities like the "ask an expert" option described above or animated help guides can assist in the collaborative learning process.

However, as pointed out, such capabilities can only be made available to new entrants where there is sufficient broadband Internet availability, which does not exist in a number of more remote locations. It is expected that these capabilities likely can be provided in most public and private schools via broadband service. Even still, the proposal above for the use of message boards, chat rooms, email, and teleconferencing was cited for groups that possess computer savvy (which is not the case for all owners/managers of new entrant motor carriers). Thus, there is value in providing some in-person group discussions as part of the overall curriculum.

Peer interactions are critical for influencing the late majority. The second-generation curriculum included a group session that enabled such peer reinforcement. As noted above, the second-generation curriculum succeeded in convincing approximately 85 percent of those who were convinced to attend the training to adopt a safety culture. That demonstrated the importance of including such peer reinforcement. Even after the collapse in attendance, for the reasons cited earlier in this report, the peer pressure in the second-generation curriculum continued to convince at least 85 percent of those participating to adopt a safety culture.

Many new entrants in the second-generation training demonstration did not have computer skills. Without proper design or assistance during the training, such trainees would be handicapped at succeeding in an exclusive e-learning environment. In addition, a slow Internet connection (e.g., dial-up or even digital subscriber line-[DSL]) often causes students (even those with good computer skills) to become frustrated and abandon the e-learning application.

For purposes of the third-generation blended curriculum, it is assumed the initial training venues will be public or private training institutions that have access to broadband Internet. Additionally, the e-learning modules must be easily accessible and must not require a trainee to have extensive computer skills.

9.1.3 Overview of Traditional Learning

9.1.3.1 Advantages

A classroom setting makes it easy to verify who the attendee is and whether he or she is attending classes. It also enables development of valuable internal group peer identification among class members, and there is the opportunity for peer pressures to positively influence the less motivated. For a portion of trainees, it is a better learning style fit.

9.1.3.2 Disadvantages

Traditional classroom quizzes generally are used to determine if students have memorized the important terms and concepts. However, asking the students to demonstrate application of this information in a real-world situation can be an expensive enterprise in a live classroom. This is because of the extensive time that must be dedicated to work with each student.

Classroom training requires a physical location, and sometimes the designated location is not convenient or easily accessible for all students. To counter this, the recommended third-generation curriculum needs to be easy to implement at many locations (and times) nationally.

9.1.4 Overview of a Blended Training Curriculum

As discussed above, in many instances, a learning strategy that includes both e-learning/testing and facilitated group interactions is more effective. Such blended training programs mix the best elements of traditional classroom learning with the best elements of e-learning. A successful blended course allows for the following:

- An increase in learning outcome measures and lowering of attrition rates versus those observed in 100-percent e-learning courses.
- An increase in trainee-instructor and trainee-trainee interaction through the use of course communication tools like electronic discussion forums.
- The ability to reserve face-to-face time for interactive activities, such as higher-level discussions, small group work, debates, demonstrations, or lab activities.(2)

Many students prefer a blended approach because it includes the following:

- **Flexible Schedule:** The e-learning portions of the curriculum offer flexibility that an instructor-led curriculum does not.
- **Greater Control:** The e-learning content offers trainees some level of control over their learning pace. Difficult concepts can be reviewed as often as necessary, and knowledge can be mastered before moving onto the next lesson. The e-learning sections of the curriculum are easily augmented to better address unclear issues.
- **Complementary Approaches:** An e-learning course augmented by the social/behavioral aspects of face-to-face group discussions with peers provides two complementary approaches that facilitate independent and collaborative learning.

9.1.4.1 Benefits of a Standard

If training is voluntary, then generally those who need it the most are the least likely to participate. Section 210(b) of MCSIA as amended by MAP-21 essentially addresses the requirement found at 49 U.S.C. Section 31144(b)(1). It requires FMCSA to establish mandatory initial requirements by which an applicant new entrant will demonstrate sufficient knowledge and understanding of the safety regulations prior to receiving an interstate USDOT number. The MAP-21 amendment requires that FMCSA define some measurement in addition to a proficiency examination to be applied to ensure the new entrant understands the safety regulations.

Educators acknowledge that mandatory training has meaningful and positive results. Requiring participation establishes an industry standard, and a standardized curriculum will provide equal access to the same learning opportunities.(14) There is also evidence that well-designed blended training programs can establish a more standardized presentation of information. Standardization can better protect the public from incompetent or outdated training practitioners at public or private training institutions.

9.1.4.2 Exclusive e-Learning Education Style

The Safety Agenda for the American Trucking Associations (ATA) states:

> The Task Force recommends new motor carrier owners, both interstate and intrastate, be required to satisfactorily complete a safety training class before commencing operation. Safety training curricula should meet uniform standards nationwide.

However, at the July 14, 2011 hearing before the Senate Subcommittee on Surface Transportation and Merchant Marine Infrastructure, Safety, and Security, the ATA representative stated that it was the association's position that new entrants should be required to take an online course before being issued a USDOT number. While that statement indicated ATA's continuing support for training as part of the knowledgeability requirement, it also appeared to narrow ATA's safety agenda recommendation to what is essentially a 100-percent e-learning recommendation.

Mandatory training that is offered exclusively via e-learning demands strict oversight by the course monitor to determine who is taking the training. In a tightly networked university setting with students, this appears to be manageable. However, in a distributed national environment with training offered in numerous remote locations by numerous third-party providers, to parties that have an incentive to "beat the system," it is not so readily manageable, and may be more likely to be subject to fraud. The ability to control who is interacting with the e-learning media is considerably undermined. The opportunities for fraud are increased. The opportunities for the recommended up-front synergies of data validation and risk-based screening would be lost.

In a tightly networked environment, the course can include tasks, projects, concepts, information, and built-in opportunities to chat, participate in discussions, and take tests, thus providing a sense of collaboration. However, trainees who are not computer literate will not be able to participate in such activities, even where there is national broadband access. In addition, the delay in responses to questions, even if an e-facilitator is provided, could pose a problem for trainees who have limited time to dedicate to this type of training.

9.1.4.3 Blended Education Style

A blended curriculum provides a mix of the traditional classroom experience with e-learning technologies and testing. This style of curriculum combines the benefits listed above for traditional classroom learning, but avoids most of the negatives. The recommended blended curriculum includes face-to-face social sharing opportunities among the trainees as peers, which is the only truly effective means for shaping beliefs and fostering adoption of a safety culture.

The recommended blended curriculum also addresses a number of comments to the docket on the August 2009 New Entrant ANPRM by recommending that an e-learning supervisor validate that the trainees are owners/managers (and not consultants or junior employees). As part of the facilitated group discussion, even those trainees who may be too intimidated to ask questions in front of others will still get the benefit of the shared opinions of their peers regarding the importance of applying safety best practices when running a motor carrier operation.

The blended concept could begin with an initial group orientation session followed by the delivery of curriculum via supervised e-learning media. In this way all trainees have the opportunity to acquire a more common level of knowledge about the safety regulations and can do so at their own pace. Well-designed e-learning modules with solid content expose the trainee to a vast array of information on many topics and prepare the trainee for follow-on peer group discussions.

While organized email discussions or threads have been used in computer-skilled groups with some positive outcomes, the variability in computer skills in the new entrant population and the requirement to consider small business needs indicate that mandatory participation in e-learning discussions (by posting and replying to topics in uncontrolled settings) is not a good choice at this point for a national standard.

9.1.5 Providing e-Learning Training to People in Remote Areas or With Limited Computer Skills

It is expected that most training institutions, public and private, are located in geographic areas with access to broadband Internet service (i.e., near towns and cities). However, where broadband Internet is not available, Web training is not an effective option.

Thus, if it is determined later that provision of the recommended training via public and private training institutions with broadband access does not provide enough locations, then providing the course materials on some other media such as CD or DVD to training entities in such parts of the country is an option to consider investigating, subject to its considerable logistical and fraud limitations. FMCSA would also need to evaluate the practicality of provision of onsite supervising facilitators and/or group learning settings and secure communication of successful graduates at such locations to the Agency.

9.2 SUMMARY OF TWO EXAMPLE BLENDED PROJECTS

9.2.1 Project Sponsored Through the State of Florida With FMCSA MCSAP High Priority Grant Funds

The Research in Advanced Performance Technology and Educational Readiness (RAPTER) team at the University of Central Florida (UCF) Institute for Simulation and Training (IST), developed a blended curriculum called the “Safety Inspector Training and Certification Program” for the Florida Department of Transportation (FDOT) Motor Carrier Compliance Office (MCCO). This was the Florida MCSAP lead agency responsible for inspecting CMVs and their drivers. The goal of MCSAP safety inspections is to improve the safety performance of commercial vehicles and drivers through proper enforcement of the FMCSRs and Hazardous Materials Regulations so that our roads are safer for the motoring public.

The State provides inspector training to new candidate inspectors on how to perform CVSA North American Standard (NAS) Level 1 roadside inspections. The training consists of two parts, referred to as Part A (Driver Inspection) and Part B (Vehicle Inspection). Then, 8 or more weeks after successful graduation from that training, inspectors begin the Field Training Officer (FTO) program.

In some cases, up to 25 percent of potential inspectors failed the required tests and thus did not graduate from the initial Part A and/or Part B courses. FDOT/MCCO desired a means for reducing the high failure rate. They also felt they needed to continue using the Part A and Part B instructor-led classroom courses, using the classroom instructor-based lecture curriculum provided by FMCSA's National Training Center (NTC).

Additionally, the FDOT/MCCO team wanted to improve retention of knowledge learned by candidate inspectors during the Part A/B training so it would better carry over to job performance in their subsequent FTO programs. Because the FTO program occurs 8 or more weeks later, in many cases, those candidate safety inspectors who graduated from the training were not retaining sufficient knowledge from the Part A/B classes. This caused the newly graduated safety inspectors to struggle through their field training.

To address both of these needs, FDOT/MCCO had the UCF IST initiate development of a supplement to the traditional NTC classroom curriculum. As part of those efforts, the State applied for and received MCSAP high-priority grant funds to complete program development they had already supported and testing of e-learning materials.

Unlike the new entrant motor carriers, which are located all over the Nation, Florida's candidate NAS inspectors all gather for the training at a centralized training location, which has broadband Internet service. Thus, there is no limitation on using a centrally administered Internet application.

Florida awarded a contract for the development of e-learning media that applies sound instructional design. The e-learning portion of the training is referred to as "The Web-based Safety Inspector Training and Certification Program." That course media allows each individual candidate safety inspector to tailor the knowledge training to his or her needs and to practice and learn through embedded quizzes and animations.

For example, a candidate safety inspector who has no previous CMV knowledge and who may struggle with learning how to evaluate hours-of-service (HOS) records for enforcement purposes would have access to this additional media when he or she returned to his or her dorm room at night to study, and could practice that particular module. In each module throughout the entire course, the candidate safety inspector can see video, animated diagrams, and high fidelity images, take practice quizzes with feedback, and more. Having the capability to use the Web-based application as a resource during their study time outside of class, candidate safety inspectors were better able to focus on their weaknesses in certain areas and be up to speed for class the following day.

Details about the Web Materials

The UCF IST team that developed FDOT/MCCO's e-learning curriculum perceived that the structure of the Federal regulations can be confusing to those not familiar with them and difficult for novices to read and understand. Thus, the training media was organized differently than the order of the regulations, while keeping a few familiar themes.

For example, the Part A and Part B training sections were retained to mirror both Part A and Part B of the classroom training on the Federal regulations. However, rather than restating regulations, each section begins with an overview, followed by an explanation.

Then, the regulations are explained using simplified text combined with interactive images, static and animated diagrams, flowcharts, video (where necessary), and safety check quizzes. Safety check quizzes provide the user with practice and feedback opportunities. Additionally, the NAS OOS criteria and regulatory guidance/exceptions are provided in specialized iconic boxes. Feedback from the trainees indicated this not only improved their learning, but made the program more enjoyable.

Upon completion of the Web-based training, the trainees had the option to complete virtual inspection scenarios to determine whether they know how to apply the regulations and OOS criteria during an inspection. This is an effective way to provide additional hands-on application of the knowledge just gained without the logistical challenge of finding a real truck to inspect.

The virtual inspection scenarios better prepare the inspectors for what they might experience in the subsequent FTO program and on the job. Results and feedback are provided immediately and in a detailed fashion so that the trainee can identify his or her particular strengths and weaknesses, and so that he or she can undertake remediation on the spot.

Results

Students who used the Web-based e-learning as part of a blended curriculum achieved highly positive results. In contrast to the up-to-25-percent knowledge failure rate, 100 percent of the trainees passed the tests for both Parts A and B. The 100-percent pass rate was maintained for all the next cycles of these course offerings that were monitored by the Web-based software developer. FDOT/MCCO was extremely pleased with the result.

Results for the subsequent FTO training were also more successful. The results are broken down into three phases, which coincide with the role of the candidate as he or she progresses through the 14 weeks of field training. Phase I consists of the trainees mostly observing. Phase II consists of candidates working with a training officer while conducting inspections. Then in Phase III, candidates are expected to conduct the driver and vehicle inspections on their own while the training officer observes and critiques. The development team decided to use these existing phases as appropriate break points for conducting performance assessments.

The team developed an objective FTO evaluation form that measured performance during these three phases of the FTO program. Results of those evaluations determined that trainee safety inspectors who had access to the Web-based knowledge materials were more prepared for the FTO phases. These trainee inspectors retained a higher portion of knowledge from the Part A and Part B training, and they performed as trainee inspectors at higher levels during all three phases of the FTO program than those who did not have access to the Web-based materials.

Table 38 summarizes the average scores received by candidate safety inspectors on the evaluation forms during Phases I, II, and III of the FTO training program. The scores are separated to show which candidates had access to the Web-based knowledge materials versus those who only had access to the traditional, instructor-led classroom curriculum. In addition to higher scores, there were no failures during the FTO portion for inspectors who had access to the Web-based knowledge materials, whereas there were failures at each stage for those who did not have access.

Table 38. Average scores of safety inspectors (non-Web-based training versus Web-based training).

Phase	Non-Web-Based Training	Web-Based Training
Phase I	2.25 (n* = 15)	4.31 (n = 35)
Phase II	4.37 (n = 11)	4.78 (n = 35)
Phase III	4.44 (n = 10)	4.91 (n = 35)

(*n = sample size)

This application of e-learning as part of a blended curriculum illustrates the success of applying adult learning theory (i.e., giving credit for what people know and teaching and applying what they do not know). The candidate safety inspectors clearly took ownership of the learning process when using this blended curriculum.

Safety inspectors come from varying backgrounds and experiences. The UCF team hypothesized that prior CMV experience would greatly improve safety inspectors' ability to identify the parts and systems of a CMV, thereby giving them an advantage over those who did not have CMV experience. Likewise, for those safety inspector candidates who had prior non-CMV law enforcement experience, the research team hypothesized that it would greatly improve their ability to identify rules and regulations and take necessary enforcement action, thereby giving them an advantage over those who did not have prior law enforcement experience.

Because the largest difference in performance for candidate safety inspectors during the FTO Program was in Phase I (which is observation only of inspections), the team examined the scores of the candidates who were in the initial Web-based training group, taking into account their previous background experience.

Table 39 gives the results, indicating that the safety inspectors who had both law enforcement and CMV experience scored higher than those who had no experience. Those who had previous CMV experience scored higher than those with only non-CMV law enforcement experience. Counter to the hypothesis, the scores for inspectors with neither background were marginally better than for those with only non-CMV law enforcement backgrounds. This likely is not a statistically significant difference.

Table 39. Further breakdown of safety inspector FTO evaluation scores for the Web-based training group at the end of Phase I.

Measure	CMV Experience Only	Law Enforcement Experience Only	No Experience	Both CMV and Law Enforcement Experience
Number (Percent) (n=35)	5 (14%)	9 (26%)	12 (34%)	9 (26%)
Average Score After Phase I	4.53	4.02	4.12	4.75

Thus, the blended curriculum was able to improve both the pass rates and information retention rates for all students. But the performance measures also supported the hypothesis that having experiential knowledge of the parts and systems of the vehicle is valuable, no matter what training is received.

A blended learning approach like this could support many entry-level training programs involving transportation, including new entrant motor carrier training, law enforcement training, and CR/SA training. Many of the modules from this existing e-learning media developed for training inspectors on roadside inspections can be readily modified into training for new entrant motor carriers.

9.2.2 National Institute of Justice

In June 2011, the RAPTER team completed development of five blended e-learning courses and two 100-percent Web-based courses for the National Institute of Justice (NIJ) Technical Working Group for Fire and Explosions (TWGFEX). The seven courses include the following topics:

- Blended Curricula:
  - Post-bomb blast investigation.
  - Fire debris analysis.
  - Fire dynamics investigation.
  - Low explosives analysis.
  - Chemistry for forensic scientists.
- Web Only:
  - High explosives analysis.
  - Chemical, biological, radiological, and nuclear awareness for first responders.

Just as with the safety inspector training for FDOT/MCCO, the prior method of instruction for the above-listed courses was exclusively traditional, instructor-led classroom workshops consisting of PowerPoint lectures supported by hands-on tabletop exercises. Due to increasing travel restrictions, limited budgets and demanding work schedules, NIJ initiated a project to determine if the addition of e-learning technology as part of a blended curriculum (using the Internet) could be a worthwhile augmentation, both to cut costs and to improve performance. The target audiences for those courses consist of lab chemists, forensic analysts, fire scene investigators, and post-blast investigators from across the country, all with diverse experience in their careers. These audiences are all located in areas across the country served by broadband Internet.

As discussed above under strengths and weaknesses of instructor-led training and e-learning, the nature of these courses led NIJ to determine that a core, hands-on, instructor-led portion must be retained as part of the course curriculum for five of the courses. This is because of the nature of the learning objectives, and the need for discussions that go beyond the scope of what can be productively included in knowledge-based material. There is also a belief by subject matter experts (supported by diffusion theory) that students greatly benefit from live interaction with their peers and instructors, specifically by becoming a member of a learning community and culture.

It was determined that the most cost-effective strategy for developing the five blended curricula was to provide the students with access to the e-learning media first for acquisition of the foundation knowledge. This approach provides for more equal knowledge attainment, thus preparing students for the live portion of the workshops. The five e-learning media modules were developed, each addressing one of the topics above. The students had 8 weeks to complete the online modules and quizzes. A combination of technologies was used in order to convey highly technical information through the Internet medium. For instance, animations were created to explain complex concepts such as how gas chromatography works, while videos were designed to portray explosion tests and experiments.

The goal for each course module (and each lesson in the modules) is to ensure that students retain a sufficient amount of knowledge in order to pass the assessment at the end of the course module. To achieve this, the team—in close working partnership with subject matter experts—designed and developed instructional content and incorporated media determined appropriate for each topic.

These blended curricula were judged by NIJ to be quite successful. The results are indicated by the improvement in success of student learning and garnered a very positive response with regard to the material and the value of the live sessions. This is based on trainees' achievements on tests, along with positive feedback collected from the trainees at the end of the test workshops.

Beginning professionals successfully acquired the foundational knowledge they needed to back up their daily activities at work, while more seasoned professionals got a refresher. Additionally, the blended programs allowed NIJ to reduce 4-day and 5-day classes to 1.5 days of class time, with no apparent reduction in student success (as measured by instructor feedback and student scores). Thus, these blended curricula enable considerable cost savings.

10. DEVELOPMENT OF FRAMEWORK

10.1 OVERVIEW

Other than the new entrant SA, which some characterize as a form of training, many new entrant motor carriers currently do not receive training on the motor carrier safety regulations. There is a common recognition within many transportation organizations that technology-enhanced training and testing methodologies and performance enhancements are becoming the practical solution for developing and maintaining the knowledge and skills needed to stay current in the dynamic environment of today's world.

Analysis of the safety performance of first-generation trained new entrants found that simple, instructor-led classroom training, even though in a voluntary environment, was highly productive for improving the safety performance of the half of the test group that took the training seriously. The ultimate goal of the second-generation curriculum research as well as the successor third-generation curriculum is for the training and testing provided to encourage the highest number of new entrants possible to understand the safety regulations and to adopt a safety culture.

This report recommends development of a blended curriculum that incorporates performance-based, technology-enhanced e-learning with facilitated group discussions. This combination of knowledge training and testing, safety culture discussions, homework, and critique/feedback would be conducted within a controlled, supervised environment where new entrant owners/managers are the exclusive participants.

The principles of flexibility, interactivity, and self-paced, performance-oriented learning have become the cornerstones of all e-learning modules and teaching methods. While very powerful, development of effective e-learning course content starting from traditional instructor-led classroom training systems is labor intensive. The process of creating the e-learning modules for a blended curriculum is one that at least several scholars admit takes the bulk of time.(15)

As an initial step in creating the blended curriculum, the contractor must conduct analysis and review of the second-generation, instructor-led training curriculum demonstrated in 2010–12, the forthcoming Web-based new entrant training modules being developed through FMCSA's NTC, and the two example blended applications described in Section 9.2, at a minimum. The first goal in creation of the recommended, blended curriculum is to document new entrant learning areas where knowledge-enhancing e-learning and testing methodologies can be productively applied.

Additional goals include the following:

- Reducing the amount of detailed, specialized knowledge that must be possessed by the e-learning supervisors and the group discussion facilitators.
- Reducing the cost of providing the knowledge training.
- Increasing the amount of guidance/help available to trainees to assist all levels of learners in understanding the material.

- Increasing hands-on reinforcement of knowledge, thus making it easier in the peer classroom environment to successfully facilitate adoption of a safety culture by the less motivated new entrants by a much larger percentage.
- Monitoring performance statistics of the new entrant graduates from each offering training school to detect if there are patterns of poor performing graduates.

The initial implementation should focus on delivery of the e-learning/testing via broadband Internet. If determined necessary, the e-learning media for areas of the country without broadband Internet service can be investigated for possible later implementation via CD or DVD.

After designing and alpha testing the blended third-generation curriculum, the entire revised version should undergo a beta test in the real world. The goal of the beta test is to measure the impacts of the training (i.e., how well it meets the intended purpose of 49 U.S.C. Section 31144(b)(1) for the the minimum knowledgeability and other requirements for new entrants outlined in MCSIA Section 201(b), as amended by MAP-21).

The contractor should work closely with FMCSA, subject matter experts, and various volunteer agencies to identify the performance outcomes required and to obtain detailed information on the new entrant audience and training environment. Then, through a series of interviews and observations, the contractor should identify gaps between desired training outcomes and practices that are currently being used.

Using structured approaches in collaboration with FMCSA, subject matter experts and key managers design tailored knowledge interventions using the best practices identified from literature and experience in other e-learning applications, such as the Safety Inspector Web-based Training program. Some e-learning applications—including modules developed for Compliance, Safety, Accountability (CSA) and the Occupational Safety and Health Administration (OSHA)—are developed using the model shown in Figure 10, below.[(16)]

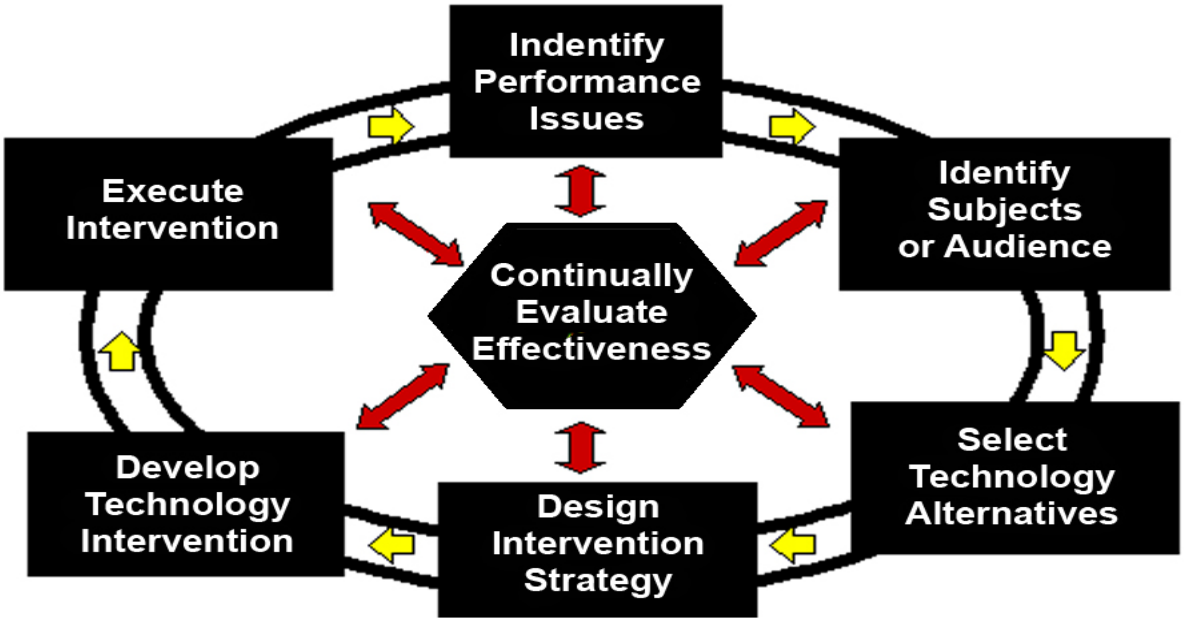

Figure 10. Diagram. The Advanced Performance Technology Model©

One of the initial activities in the model shown above involves the collection of demographic data related to the target audience identified for training ("Identify Subjects or Audience"). Previous research has established that a number of new entrants do not have much knowledge about computers, although this is changing. These are two important details about the target audience that have already been identified.

10.2 FRAMEWORK OF BLENDED TRAINING

10.2.1 Attributes of the Web-Based Safety Inspector Training and Certification Program That May Be Useful for New Entrant Training

MAP-21 requires the proficiency examination to address much more than the 16 mandatory criteria for failing a SA and the 7 criteria that initiate an expedited action enumerated in the current new entrant final rule. Also, other research looking at the effectiveness of the New Entrant Program found that those criteria are not highly correlated with predicting future crash rates. Nonetheless, through analysis of the e-learning modules that UCF IST included in the Web-based Safety Inspector Training and Certification Program used by FDOT/MCCO, it was determined that material on many of the regulations covered by these criteria was already developed for those software modules. Because that material was developed using MCSAP high-priority grant funds, it is in the public domain, and is available to be leveraged for providing training to new entrants, specifically to facilitate understanding of the safety regulations.

A summary of regulatory information already contained in that training and testing media is presented below. This is grouped within the context of the 16 mandatory criteria for failing a SA. These modules need to be reviewed to determine whether the embedded training and testing is sufficient for what FMCSA may want to require for new entrant proficiency testing in the areas covered.

10.2.2 Mandatory Safety Audit Failure Criteria and Other Available Training Materials

The alcohol module within the FDOT/MCCO Web-based program focuses on inspecting the driver for alcohol violations. Regulations for 392.5 and 382.107 are discussed, as well as regulatory exceptions. The regulations are rewritten in plain language with links to the actual regulations on the FMCSA site. This section of the course could be expanded to include 382.115, 382.201, 382.211, 382.215, and 382.305 for purposes of SAs/CR statutes. The 16 mandatory criteria for failing a SA are outlined and discussed in order, below.

1. Section 382.115(a)/Section 382.115(b)—Failing to implement an alcohol and/or controlled substances testing program (domestic and foreign motor carriers, respectively).
2. Section 382.201—Using a driver known to have a blood alcohol content of 0.04 percent or greater to perform a safety-sensitive function.
3. Section 382.211—Using a driver who has refused to submit to an alcohol or controlled substances test required under part 382.
4. Section 382.215—Using a driver known to have tested positive for a controlled substance.
5. Section 382.305—Failing to implement a random controlled substances and/or alcohol testing program.

Within the FDOT/MCCO Web-based program, there is an entire module that focuses on the commercial driver's license (CDL). The module discusses how to determine appropriate CDL class, describes the differences between U.S., Mexican, and Canadian CDLs, describes CDL endorsements/restrictions, and explains the different OOS criteria/revocations involved with CDL regulations. This entire module may be relevant to new entrant motor carriers. Regulations discussed are 383.23, 383.51, 383.91, 383.95, and 391.11. Material could also be added for excepted drivers under 383.71(a)(1)(ii)(B). A good portion of this module can be leveraged to train commercial motor carrier management for SAs and can be expanded upon to include any safety-audit-specific regulations.

6. Section 383.3(a)/Section 383.23(a)—Knowingly using a driver who does not possess a valid CDL.
7. Section 383.37(a)—Knowingly allowing, requiring, permitting, or authorizing an employee to drive with a CDL that is suspended, revoked, or canceled by a State or who is disqualified to operate a CMV.
8. Section 383.51(a)—Knowingly allowing, requiring, permitting, or authorizing a driver to drive who is disqualified to drive a CMV.

There are no existing modules in the Web-based inspector training for the following two mandatory failure criteria for the SA:

9. Section 387.7(a)—Operating a motor vehicle without having in effect the required minimum levels of financial responsibility coverage.
10. Section 387.31(a)—Operating a passenger-carrying vehicle without having in effect the required minimum levels of financial responsibility.

The existing FDOT/MCCO Web-based safety inspector program has a module dedicated to driver qualifications. This module discusses driver qualification requirements as well as exemptions. Additionally, the module describes required medical documentation, including medical certificates, physical examination forms, skills performance evaluations, and the OOS criteria for violation of regulations. The regulations associated with this module include 391.2, 391.11, 391.15, 391.41, 391.43, 391.49, and 391.61-391.71. This module could be expanded to include 391.15. It could also include practice scenarios to determine whether a driver is either unqualified or disqualified. Note, the disqualification information in Section 391 is largely duplicative of the CDL regulatory material in Section 383.

11. Section 391.15(a)—Knowingly using a disqualified driver.
12. Section 391.11(b)(4)—Knowingly using a physically unqualified driver.

The HOS module discusses the rules and regulations for property and passenger-carrying vehicles. The module has an interactive log book, quizzes, and practice scenarios on the 11-, 14-, 60-, and 70-hour rules, and discusses procedures for identifying false logs. It also briefly delves into electronic logging devices. Finally the module describes the OOS criteria for HOS. The main regulations discussed are 395.1, 395.2, 395.3, 395.5, 395.8, 395.13, and 395.15. This is a very thorough, interactive module that could be of great use to motor carrier management in preparation for SAs.

13. Section 395.8(a)—Failing to require a driver to make a Record of Duty Status (RODS).

There are no existing modules in the Web-based inspector training for the following three mandatory failure criteria for the SA:

14. Section 396.9(c) (2)—Requiring or permitting the operation of a CMV declared OOS before repairs are made.
15. Section 396.11(c)—Failing to correct OOS defects listed by driver in a driver vehicle inspection report before the vehicle is operated again.
16. Section 396.17(a)—Using a CMV not periodically inspected.

The common reasons causing failure of the SA are the following:

- Not having a Drug and Alcohol Program for drivers who operate vehicles requiring a CDL.
  - This program should be in place by the time the SA is conducted.
  - This includes: having pre-employment drug testing, random drug and alcohol testing, and other testing as required.
- Not having records of having completed periodic (annual) inspections.
- Not maintaining for 6 months the required RODS required for monitoring compliance with the HOS requirements for driving.
- Not maintaining the required minimum level of financial responsibility through insurance.

- Drivers not having a valid license (CDL or otherwise) and/or any required endorsements for the vehicle they are driving.

In summary, there are no identified existing training modules for 5 of the 16 mandatory SA failure requirements. These would need to be found elsewhere, or they would need to be developed. Thus, the contractor will need to review what additional materials would best support the knowledge training and proficiency testing materials for areas not yet developed by other applications. It may be there are additional areas that can be leveraged from the Web-based Safety Inspector Training and Certification Program. There presumably will also be material in the five modules being developed by FMCSA's NTC, and from other States that can be leveraged.

The goal of the training and proficiency examination is much broader than just facilitating passing the SA. There are many activities that can contribute to poor safety performance measures and crashes. For example, the second-generation curriculum applied in Montana includes a presentation by SCORE on the importance of business management, the importance of developing a business plan, and the monitoring of financial data. Ignoring these can get a new entrant in financial trouble, making it difficult to maintain a safe operation.

FMCSA initiated a separate exploration with the Small Business Administration (SBA) in July 2012 relating to the development of such materials (geared toward small motor carriers, which would include virtually all new entrants) for posting on the SBA Web site. If that should become available, that work could presumably be leveraged or linked to in order to provide that basic business training to new entrants. This could also be provided via private sources.

10.2.3 Ensuring the New Entrant Understands the Regulations

MAP-21 adds a new requirement to 49 U.S.C. 13902(a)(1). This is the portion of the U.S.C. that requires for-hire motor carriers to obtain operating authority. More specifically, it states that every motor carrier requiring operating authority must first pass a written proficiency test.

In the same section of MAP-21 establishing the requirement that for-hire motor carriers must pass a proficiency test, it also makes a conforming amendment to MCSIA Section 210(b), which is a note to Section 31144. This is the portion of the U.S.C. that requires every motor carrier to obtain a USDOT number, and requires those operating interstate to also pass a proficiency examination, and other requirements as necessary to ensure the new entrant applicant understands the safety regulations before being issued an interstate USDOT number.

Numerous comments to the docket in response to the August 2009 ANPRM on the Section 210(b) knowledgeability requirement highlight concerns as to whether a proficiency examination alone can meet the requirement of ensuring that the owner/manager of the new entrant company understands the safety regulations.

Thought needs to be given to what appropriate training and testing might be, and how it should be delivered to meet this requirement in a cost-effective manner. The blended training curricula developed for both FMCSA inspector training and NIJ fire and explosions training uses quizzes throughout the modules to perform knowledge checks. Five of the NIJ curricula also use group sessions (referred to as roundtable discussions) as part of the day-and-a-half classroom portion to ensure understanding.

Testing could be divided into three categories of evaluation. First, a diagnostic test should be administered to initially determine what each applicant new entrant does or does not know. Based on that information, the facilitator may tailor the supervised e-training knowledge session(s) for each new entrant.

Second, the testing throughout the e-learning modules should determine whether the new entrant has demonstrated proficiency in the necessary knowledge by conclusion of the e-learning portion of the training. This assessment could be implemented with a single, proctored proficiency examination. However, with e-learning it is common to include testing throughout as part of the reinforcement process and it is advisable to spread quizzes throughout the material as it is being presented. An electronic testing process also makes it more cost-effective to grade tests and to monitor overall performance (i.e., identify where changes are needed to both the training media and tests).

Third, there should be a formal attempt to measure how well the new entrant understands the regulatory requirements and whether he/she has embraced the concept of a safety culture. This is best done with human interaction, similar to what NIJ is using in the classroom portion of their blended curricula.

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11. DEVELOPMENT, ALPHA AND BETA TESTING TO REFINE

11.1 DEVELOPMENT OF BLENDED NEW ENTRANT TRAINING CURRICULUM

This is Phase I of a four-phased process. Only the first three phases are laid out in detail in this section. The fourth, evaluation of the effectiveness, will be discussed in Section 12.

11.1.1 Technical Analysis Approach

Fortunately, as outlined throughout this report, development of the recommended third-generation blended curriculum is starting from a position where a considerable amount of existing materials are available. Analysis could be limited to only what is necessary to produce a reasonable alpha test and then beta test demonstration curriculum. The intent is for the process to be dynamic. Thus, the initial version is expected to be modified based on a simple alpha test. Similarly, the media will be modified further based on a more significant beta test. The media will continue to be dynamic, and thus be modified continuously based on feedback from the operational training and testing. The goal should be to improve the curriculum continually based on lessons learned and feedback from its application.

Extensive reference materials have been assembled in conjunction with this report. Considerable Web-based materials are also expected to be available when FMCSA publishes the multi-module Web-based new entrant training being developed through the NTC for deployment on the FMCSA Web site. Various States also have very good materials (e.g., Kansas and North Carolina).

With the available resources and reference materials, it is anticipated that development of the initial version of the curriculum should be accomplished quickly. It is estimated that it would take about 1 year to complete development of the initial third-generation blended curriculum (see Section 11.5 for period of performance details).

The front-end analysis process should be carried out in several overlapping stages. It should include a review of relevant directives and regulations, onsite observation, and interviews. Interviews should include FMCSA managers, State safety auditors, the researcher's personnel, and representatives of new entrant companies. This would result in a list of specific learning outcome requirements with metrics that can be used.

The next stage (overlapping the first) is an examination of the needs of the target trainees. As with the first stage, it would be beneficial for the contractor to coordinate with the first- and second-generation Montana research contractor regarding previously-performed onsite interviews and observations of training participants (both new trainees who are currently successful and those just starting out who aspire to be successful).

For example, members of the trucking industry are quite diverse. One study indicated that the average commercial vehicle operator is 47 years old and, historically, many are not particularly computer literate. Many new entrants come from these same operators who have acquired a CMV and are now operating for themselves. The second-generation new entrant training in Montana also found limited computer literacy, which is consistent with what was encountered in the first-generation training in that State. There could be regional differences. Other studies have found that the percentage of truck drivers using the Internet is at least 60 percent. But that still leaves a large number who are not. This may or may not be a reasonable surrogate for the Internet capabilities of new entrant carriers.

In general, older individuals and/or those who live in rural areas tend to require a different type of training interface than individuals from the younger "Next Gen" population. The latter are familiar with graphic user interfaces, smartphones, video games, etc. As mentioned above, the better the learning needs are described for the target audience, the more accurately the curriculum materials can be crafted to fit the variety of those needs.

Research has shown that the physical training site is often a critical factor in designing new technology-based training. Hardware, software, Internet connection method (e.g., modem, digital subscriber line, satellite, broadband, etc.), and who shares the systems are critical pieces of information that must be carefully determined to ensure the training can be successfully implemented. The recommendation for initial implementation is via the Web and possibly later via DVD to serve geographically-distributed unconnected environments.

The planned method of delivery for the initial third-generation curriculum is via the Internet at specified locations (public and/or private third-party schools). The initial implementation of this third-generation curriculum will focus on computerized environments with broadband Internet connectivity, using standard computer equipment with Web browsers, keyboards, etc. The alpha and beta tests should include testing of the e-learning software to ensure that, if determined appropriate, it could be used later in a standalone environment on CD or DVD.

Just as FMCSA does for field support of information system capabilities used as part of MCSAP enforcement activities, the contractor will recommend to FMCSA the minimum level of computer capability requirements for training facilities that want to offer this training and testing curriculum. The minimum software and equipment requirements will need to be revised occasionally as technology progresses and as the training media are modified. Trainees will also need access to printers in order to print out exercises, job aids, reference materials, and/or test results.

The software needs to be able to control transmission of individual testing results in a secure fashion. When FMCSA establishes that satisfactory completion of training, quizzes, a proficiency examination, and other requirements are required before issuance of an interstate USDOT number, it will be important for FMCSA to receive secure electronic documentation of successful completion. The methodology developed should consider options for preventing fraud by those who falsely claim completion of the training.

<u>Detailed Recommendations for the Training</u>:

Within reason, public community colleges or private third-party training schools that possess the established minimal computer equipment, software and broadband Internet capabilities, etc., could be candidates for offering the training and the required proficiency examination using the proposed blended curriculum.

The following recommendations are offered:

- The e-learning should be supervised to control and document who is taking the training, validating that data for the carrier and noting that they plan to operate interstate. The supervised setting should also be used to help identify possible reincarnating carriers.
- The training should begin with a short group orientation, followed by implementation of an initial computer-based diagnostic test to determine each applicant's approximate level of knowledge.
- Based on those results, the e-learning supervisor should tailor the e-learning course assignment for the applicant.
- Proficiency examination questions should be embedded throughout the e-learning training materials, sufficient enough to meet the MAP-21 requirement found in Section 32101(b) & (c).
- Detailed statistics should be kept to evaluate which questions are proving difficult for what type of new entrant. This information should also be used to target where the knowledge training and/or knowledge test questions need to be refined.
- If the new entrant does not satisfactorily pass the proficiency examination for a portion of the e-learning, the new entrant should repeat that section or complete some remedial material.
- The test question bank should be designed to have multiple questions for each category objective. This is so that equivalent—but different—knowledge test questions are presented to new entrant trainees who repeat a section of the e-learning to ensure they have not memorized the questions and that the knowledge shortcoming has been resolved.
- The initial e-learning media for the training should run centrally via the Internet.
- The e-learning should offer scenarios that describe various situations, affording students the opportunity to apply their knowledge and receive feedback on their ability to apply that knowledge for what the correct course of action should be. These scenarios should include simulated examples of the required recordkeeping for the new entrants to practice completing.
- For some, there may be a need for additional remedial training. If those who require remedial training continue not to pass the proficiency examination for that portion of the e-learning, further intervention needs to be arranged. At some point, it will be necessary to determine through some specified process whether or not that applicant is qualified to obtain an interstate USDOT number.
- The computer-based administrative capabilities should include things such as: student registration, progress tracking, recording of quiz responses, support statistics (such as frequency that each question is incorrectly answered, to target where improvements are needed), and other necessary administrative requirements.

- After trainees have achieved somewhat comparable levels of knowledge from the e-learning, they would move into the next stage of training in facilitated/mentored sessions at the training facility. The goal of these sessions is to ensure understanding of the safety regulations, explaining why they are important, and to promote adoption of a safety culture.
- As part of the beta test, facilitators could also use the group sessions to determine strengths and weaknesses of the training modules and objectives. Alternatively, they could use an exit interview process, which could be correlated with the knowledge test results to measure the effectiveness of the curriculum. Either way, qualitative feedback should be obtained to tailor recommendations for future enhancements to the knowledge training.
- Following completion of the e-learning portion and the group discussions, the new entrants would independently prepare their required recordkeeping files and have them critiqued for verification of completeness.
- For those who successfully complete all the requirements, a certification of proficiency would be securely, electronically transmitted by the training entity to FMCSA. This should include identification of both the applicant and the training entity, and FMCSA should keep this data as part of the carrier's record (perhaps as part of the MCMIS census record) so that the Agency can monitor and rank the safety performance of graduates from each school as part of its oversight functions.
- FMCSA should monitor the safety performance of new entrants by the training entity where they received the training and testing in order to identify possible entities with a pattern of poor safety performance by their graduates.
- In the future, it could be determined if it is necessary to develop a standalone version of the same process for new entrant candidates living in geographical areas without broadband Internet service. The training materials from the Web-based system could be distributed to these new entrants via CDs or DVDs. This would create significant administrative issues, and thus may not be appropriate to pursue. Thus, consideration of such an approach should include examination of whether it can meet the security and logistical requirements.

Results from the first three stages described above will be assembled to establish a foundation for the total requirements. This set of recommended requirements will be reviewed by FMCSA. Once approved, this will form the basis of the next phase, which is the design of the e-learning materials, the classroom materials, and training for the facilitators.

11.2 DESIGN

The fourth stage of the model development is design of the curriculum materials, which is actually the translation of all the previous sets of requirements into a blended curriculum that includes both e-learning technology and facilitated group sessions.

Historically, many adult learning programs have not incorporated hands-on learning. Hands-on learning allows students to reinforce learned knowledge by actually practicing and receiving feedback on how well they are applying a new skill or procedure. For many, the “doing” is an important piece of the learning. Thus, the e-learning portion of the third-generation new entrant curriculum will offer practical opportunities throughout for trainees to complete example requirements (with feedback), each followed by a proficiency examination on the procedure or skill. As noted above, if they do not pass that proficiency check, they will be cycled back for further training.

Throughout the design process, a blueprint of the learning and testing intervention should be developed. This “blueprint” should describe the learning objectives and sub-objectives, the sequence of events, and a learning/testing strategy. Namely, it will determine at what point practice exercises and quizzes should be inserted and how remediation should occur if a student is not performing as required.

11.3 DEVELOPMENT AND ALPHA TEST

Knowledge training modules will also need to be developed for training the e-learning supervisors and the group discussion facilitators. The facilitator training should cover descriptions of what will be presented in mentoring discussion formats and suggestions for how to cultivate the discussions.

Next, the “design of experiment” or experimental design should be applied. This is a statistical technique used to examine the main distracting factors (independent variables) that affect the learning performance (dependent variable) of students. By varying the settings of the factors, it is possible to study the effect of the factors along with their interactions on the outcome variable, which is the safety performance of trained new entrants.

While developing materials for the third-generation blended curriculum, multiple types of elements should be reviewed and evaluated. The goal is to ensure that implementation of the training modules is accomplished in multiple States (that are nationally representative) and that minimal issues remain. The potential barriers to implementation will likely be 1) supervisors, 2) the availability of qualified mentoring facilitators, and 3) integration of the new curriculum into operational training environments.

The developer must conduct a limited alpha test to identify if there are obvious issues and correct them before a larger multiple-State beta test is undertaken.

11.3.1 Deliverables

The initial intended deliverable is a blended curriculum consisting of e-learning training materials for new entrant motor carriers, e-learning supervisors and mentoring group facilitators, and an evaluation system.

The training for e-learning supervisors must include their non-training administrative facilitation roles. These may include:

- Managing challenges relating to potential audience attitudes toward e-learning methods.
- Ensuring that the individual completing the training is the owner/manager of the applicant new entrant company.
- Ensuring that the MCMIS census data describing the company is accurate.
- Collecting sufficient documentation to help determine if the applicant may be attempting to reincarnate.

11.4 BETA TEST

The contractor—in coordination with FMCSA and other designees—will plan how to monitor and support a live beta test of the curriculum. During the beta test, new entrant achievement data will be collected and analyzed to support evaluation of training effectiveness for ROI analysis and to identify necessary curriculum improvements.

The goal of the beta test will be to validate these curricula and provide feedback for refinements.

The beta test should be deployed in at least three States. One State should be Montana, to preserve comparability with the two sets of available data from the first- and second-generation new entrant training interventions. The other States should have good broadband Internet service and should have a different composition of motor carrier types and geography (e.g., a State in the southeastern United States and/or in the plain States).

The initial beta implementation of the third-generation curriculum should be broadband-based.

The beta test must accomplish two distinct things. One is to verify and refine the curriculum. The other is to refine an estimate of cost-benefits from application of the third-generation curriculum for use in the rulemaking supporting statement.

A portion of applicant new entrants may arrive at the training site with little-to-no e-learning experience and may need additional assistance. Some may be generally uncomfortable with computers. Both of the previously-applied first- and second-generation new entrant training curricula demonstrated that such diversity in computer literacy continues to exist. There may well be variability in the level of computer literacy in different regions of the country.

There should be some flexibility around the core curriculum so that the trainee or supervisor can individually tailor the e-learning training modules to fill a new entrant's knowledge gaps, or to supplement particular knowledge requirements within a particular segment of the industry in which that new entrant will be operating. Examples include tie-down requirements for flatbeds, regular HM versus HMSP carriers, tank truck role over, HM tank truck considerations, etc. This flexibility will allow supervisors to add or adjust instructional modules for certain new entrants, making the training more relevant. Such specialized modules can also be added and enhanced over time.

Other issues to address:

- What training tools are needed for e-learning supervisors?
- What training tools are needed for group discussion facilitators?
- What knowledge and skills make up best practices?

11.4.1 Peer Review

A group of partners should be identified for technical review/testing of the new curriculum. This is a standard FMCSA research process that will support later rulemaking. Input from peer reviewers has proven to be very helpful in developing outstanding solutions that are valid, efficient, and tested.

Possible parties to consider for inclusion in such a review group are as follows:

- The lead MCSAP agency in each of the States where the curriculum is beta tested.
- The FMCSA Division offices in each State where the curriculum is beta tested.
- Local and national CMV industry leaders.
- Training experts.
- Enforcement representatives from CVSA.
- Truck and bus associations such as ATA, the Owner-Operator Independent Drivers Association, the American Bus Association, and the United Motorcoach Association.

11.4.2 Goals

Goals of the blended, third-generation new entrant curriculum include:

- New entrant training that successfully fosters establishment/adoption of a safety culture, thus reducing crashes and fatalities.
- Make it easier to identify and prepare the large pool of needed supervisors and facilitators for a national implementation. (The supervisors help with the e-learning and the facilitators help with the group discussions in many locations.)
- Reduce the cost of training and testing while increasing the effectiveness.

11.4.3 Work Plan

The following is an example of a proposed plan outline that encapsulates many of the above discussions. The foundation of this outlined approach is a process to achieve integration of e-learning, proficiency testing, group discussions, homework preparation, and beta testing. This would be conducted through the following process:

- Update/review new entrant requirements and objectives.
  - 49 U.S.C. Section 31144 and note from MCSIA Section 210(b) as amended by MAP-21.

- Relevant FMCSA directives, policy memorandums, etc.
- Current research on transportation training best practices.
- The Montana contractor's new entrant training review.
- Subject matter expert interviews:
  - Panel of expert trainers.
  - Panel of experienced new entrants.
  - Second-generation Peer Review Committee as subject matter experts.
- Results from New Entrant Program review.

- Modify/design e-learning training and testing content for supervisors of the e-learning, new entrant motor carriers, facilitators of the facilitated group sessions, classroom discussions, homework assignments, and critique.

- Develop initial broadband-based version of e-learning media for delivering the training, testing, and instructional materials.
  - Supervised e-learning via the Web (with supervisor available for discussion, questions, testing, and administrative functions).
  - Facilitated classroom discussions.
  - Homework.
  - Critique of homework.
  - Investigate whether it would be practical to consider possible later implementation of a CD/DVD e-learning and testing version with a supervising mentor/facilitator available for discussion questions, followed by facilitated classroom discussions, homework, and critique.

- Beta studies to test and verify third-generation curriculum with respect to:
  - Functionality: verify that all applications function correctly.
  - Completeness: verify that the content provided is appropriate and complete.
  - Usability: ensure that the instruction affords intuitive use by novice users.

11.5 PERIOD OF PERFORMANCE

The project should be divided into four phases: development, alpha testing/validating, beta testing, and evaluation. Because the initial goal is to develop an initial blended curriculum, not a final curriculum, and there are considerable course materials available, it is assumed that Phase I development can be accomplished within less than a year. Thus, the approximate development time for a working draft is estimated at 9 months. Phase II, the alpha test and quick fixes of obvious issues is estimated at 3 months. Phase III, the beta test and refinement of the curriculum, is estimated at 1 year. Thus, the elapsed time for the first three phases—development, testing, and refinement of the curriculum—is estimated at approximately 24 calendar months.

12. EVALUATION

Phase IV is envisioned as a follow-on evaluation of the effectiveness of this third-generation curriculum. The time necessary to accumulate sufficient safety performance data for evaluation of the trained (and control) new entrants was about 5 years for the second-generation training. Perhaps a different methodology could be applied to accomplish some form of evaluation that could be carried out in parallel with development of the required NPRM (and evaluation of comments received to the NPRM).

After development of the blended curriculum, a separate follow-on evaluation of effectiveness should be carried out to verify the overall effectiveness of the curriculum. This evaluation would include application of the new training and testing curriculum and analysis of the results.

This phase could be modeled after the evaluation that was performed for the 2005–06 first-generation training and replicated for the 2010–12 second-generation training. Thus, work on development and publication of the required NPRM can proceed in parallel. However, to provide something timelier during the rulemaking process, some alternative methodology will be needed.

In the case of motor carrier safety performance data, there are many moving parts, some of which can change over time. Thus, for analysis of the first-generation new entrant training applied in Montana, researchers used an intervention and control group that originated during the same time period, rather than a pre- and post-analysis approach. That approach allowed all measurements to occur in the same temporal period, and it allowed for use of an evaluation design of the training intervention group and control groups (see Sections 2 and Section 3 of this report). This was slightly modified for evaluation of the second-generation curriculum because the Montana carriers who declined the training were a known group (see Section 5 of this report).

<u>Research Questions</u>:

- What is the best way to employ advanced training technology to help new entrants meet FMCSA requirements?
- What refinements to facilitator methods and training processes will be necessary to achieve the desired learning outcomes most efficiently?
- How well does the blended curriculum foster adoption of a safety culture and thus reduce risk (i.e., how does it affect new entrant safety performance measures, including crashes and fatalities)?
- What statistics should be collected to enable analysis of the training's impact on new entrants' safety performance?

<u>Site and Sample Size</u>:

- The second-generation new entrant training provided a sample of slightly more than 200 new entrants that completed all the requirements. There was also a very small group of new entrants that completed the orientation, but did not complete the homework or participate in the mock audit. During the first-generation effort, 221 new entrants were trained. Of the 221, 107 did not complete the homework. Thus, the sample size from the second-generation curriculum for those carriers that completed the homework was almost twice the size of the carriers that completed the homework from the first-generation dataset. As such, there may be some guidance from the analysis of the second-generation training for recommended sample size needed for the evaluation.

- Metrics and/or criteria for evaluation should coincide with those used in the analysis of the first- and second-generation curricula. It might be useful to add a measurement of new entrant knowledge achievement in an end-of-course proficiency test.

Variables:

- Establish any additional performance metrics and evaluation methods—beyond those used in the analysis of the first-generation and second-generation training—to support training effectiveness and ROI analyses for e-learning and other interventions. For example, scores associated with the proficiency examination could be compared.
- The control group might largely be from surrounding States, following the same logic used to develop the control group used in Montana (see Appendix D).
- The evaluation should record all descriptive information so that the reactions and performance of the various test and control groups can be compared.
- Data collected could include quiz scores, student and mentor surveys, proficiency examinations, etc. This is in addition to the safety performance data normally collected for MCMIS and CDLIS to evaluate the impact on safety performance on the road.
- The subcontractor that analyzed the safety performance data from the first- and second-generation training developed a thorough analysis process that evaluated the effectiveness of the first- and second-generation curricula in achieving desired behavioral modification. That analysis process compared measures of the safety performance of the intervention groups against those of representative control groups. The same process could be adapted and applied to the third-generation curriculum to maintain consistency. The safety performance data routinely collected by existing FMCSA monitoring mechanisms (MCMIS and CDLIS) would be used.

APPENDIX A: LEARNING/TRAINING THEORIES

E-learning has evolved over the past 2 decades since it was first implemented in the Department of Defense. Initially it was restricted to novice training and required reading. It is now branching out to a number of different arenas, from private sector job certification to Government accountability. This evolution is driven by several primary factors: first, the expansion of technology in learning and everyday lives; second, the cultivation of learning theories that aid e-learning development and delivery; third, the reduction in funding for travel and per diem at centralized locations coupled with the demand for greater results in information retention and training; and last, the need to provide training at lower costs to the public.[17, 18, 19]

Paper tests, books, and lectures were the cornerstone of traditional teaching methods for nearly all training topics. To facilitate the transition from traditional training to e-learning, educational strategies which took the best teaching practices from the real world and recreated them for success in the digital world were adopted. For example, constructivist learning theory addressed many of the topics that today's trainers worry about, such as maintaining subjects' attention, accountability, and subject differences.

Constructivist learning theory incorporated the cognitive information processing theory, which essentially states that learner attention is wavering and finite. Thus, the richness and interactivity of the information provided creates the flexibility necessary for the student to engage in the learning that is most attractive for that person. This ultimately helps the student retain the information presented.[20] This illustrates that one of the primary concerns of incorporating e-learning—the fear of losing student attention—is actually negated by the delivery of information and activities through constructivist e-learning, where information is reinforced through practice and then measured through examination.

These principles of flexibility, interactivity, and self-paced, performance-oriented learning have become the cornerstones of all e-learning modules and teaching methods across the private and public sectors. However, finding the right learning theory and delivery method is only half the battle. The other half is finding a way to translate the course content of traditional training systems into this new delivery method. This translation process, several scholars admit, takes the bulk of time for development of good e-learning modules.[21]

When talking about delivery methods for a standardized national curriculum, e-learning has to address the topics of Internet access, computer literacy, and accessibility. As Judy Brown describes, advances in technology and accessibility are bridging gaps that once seemed daunting in regard to transitioning from traditional training to e-learning.[22] For instance, e-learning is in the early stages of evolving into mobile learning, or M-learning, to facilitate learning and training by using broadband technology and a growing number of smart devices, which a growing number of individuals already own .[23, 24, 25, 26]

Another issue which has been overcome with e-learning is the issue of attention and accountability. Several studies have been conducted to determine whether or not digital teachers can keep the attention of students outside of their immediate presence. Condie states that technology, activities, assignments, tests, and tools have all evolved in proximity to each other.[27] That has allowed most of the issues associated with student attention to be improved just through the materials and lessons disseminated through e-learning. In other words, issues of attention and accountability rest with the organizations and groups who employ e-learning.

E-learning is designed in a way which prevents a "just going through the motions" type of learning. It actually challenges the student to interact with the learning module, which produces answers, completes tests, and thus shows that learning retention is occurring. When policies or administrative oversight become lax, motivation to participate in e-learning fails. Thus the motivation to keep one's job or position by using the learning program becomes the motivation, rather than the teacher or digital instructor relentlessly berating the class.[28, 29, 30] When FMCSA requires that a proficiency examination be administered as part of the training to obtain an interstate USDOT number, then that will become the motivation to complete the training.

Without such policies in place, similar to an administrator not keeping track of teachers' pass/fail statistics, learning will never be accomplished as thoroughly. Comments to the docket for the August 2009 ANPRM on new entrant knowledgeability raised concerns about administrative oversight of who is actually completing the training/testing. The recommended solution in this report follows the lead used in the second-generation training in Montana. Namely, it is to require supervisors of the e-learning portions to perform the oversight and recordkeeping that ensures the owners/managers of the applicant new entrants are completing the training and testing. Without such supervision there is no way to track who is participating.

Diffusion theory predicts there will be a percentage of very resistant new entrants that will pass the training and proficiency examination, but will still reject adopting a safety culture (see Appendix C). Thus, lack of motivation and lack of perception that a safety culture is needed can be a problem. This is another reason why a blended curriculum including peer discussions on the importance of following the safety regulations is predicted to foster adoption of a safety culture more successfully.

"Learning by doing" typically has a greater impact on more students. This is because it is very similar to the natural learning process. It grants students the opportunity to "place" the task in an appropriate context while reflecting upon what has been learned. However, objectives must be clear and realizable. If not, there is the risk of students becoming unmotivated and indifferent.

APPENDIX B: BACKGROUND INFORMATION

49 U.S.C. SECTION 31134; MAP-21 REQUIREMENT FOR A PROFICIENCY REQUIREMENT; CONFORMING AMENDMENT TO MCSIA SECTION 210(B); AMENDED NOTE TO 31144; AND NTSB RECOMMENDATION

SECTION 31134. REQUIREMENT FOR REGISTRATION AND USDOT NUMBER

(a) In general.--Upon application, and subject to subsections (b) and (c), the Secretary shall register an employer or person subject to the safety jurisdiction of this subchapter. An employer or person may operate a commercial motor vehicle in interstate commerce only if the employer or person is registered by the Secretary under this section and receives a USDOT number. Nothing in this section shall preclude registration by the Secretary of an employer or person not engaged in interstate commerce. An employer or person subject to jurisdiction under subchapter I of chapter 135 of this title shall apply for commercial registration under section 13902 of this title.

(b) Withholding registration.--The Secretary shall register an employer or person under subsection (a) only if the Secretary determines that--

(1) the employer or person seeking registration is willing and able to comply with the requirements of this subchapter and the regulations prescribed thereunder and chapter 51 and the regulations prescribed thereunder;

(2) during the 3-year period before the date of the filing of the application, the employer or person is not or was not related through common ownership, common management, common control, or common familial relationship to any other person or applicant for registration subject to this subchapter who, during such 3-year period, is or was unfit, unwilling, or unable to comply with the requirements listed in subsection (b)(1); or

(3) the employer or person has disclosed to the Secretary any relationship involving common ownership, common management, common control, or common familial relationship to any other person or applicant for registration subject to this subchapter.

(c) Revocation or suspension of registration.--The Secretary shall revoke the registration of an employer or person issued under subsection (a) after notice and an opportunity for a proceeding, or suspend the registration after giving notice of the suspension to the employer or person, if the Secretary determines that--

(1) the employer's or person's authority to operate pursuant to chapter 139 of this title is subject to revocation or suspension under sections 13905(d)(1) or 13905(f) of this title;

(2) the employer or person has knowingly failed to comply with the requirements listed in subsection (b)(1);

(3) the employer or person has not disclosed any relationship through common ownership, common management, common control, or common familial relationship to any other person or applicant for registration subject to this subchapter that the Secretary determines is or was unfit, unwilling, or unable to comply with the requirements listed in subsection (b)(1);

(4) the employer or person refused to submit to the safety review required by section 31144(g) of this title.

(d) Periodic registration update.--The Secretary may require an employer to update a registration under this section not later than 30 days after a change in the employer's address, other contact information, officers, process agent, or other essential information, as determined by the Secretary.

(e) State authority.--Nothing in this section shall be construed as affecting the authority of a State to issue a Department of Transportation number under State law to a person operating in intrastate commerce.

49 U.S.C. § 31144: SAFETY FITNESS OF OWNERS AND OPERATORS

(a) In General—The Secretary shall—

(1) determine whether an owner or operator is fit to operate safely commercial motor vehicles, utilizing among other things the accident record of an owner or operator operating in interstate commerce and the accident record and safety inspection record of such owner or operator--

(A) in operations that affect interstate commerce within the United States; and

(B) in operations in Canada and Mexico if the owner or operator also conducts operations within the United States;

(2) periodically update such safety fitness determinations;

(3) make such final safety fitness determinations readily available to the public; and

(4) prescribe by regulation penalties for violations of this section consistent with section 521.

(b) Procedure.--The Secretary shall maintain by regulation a procedure for determining the safety fitness of an owner or operator. The procedure shall include, at a minimum, the following elements:

(1) Specific ***initial*** and continuing requirements with which an owner or operator must comply to demonstrate safety fitness.

(2) A methodology the Secretary will use to determine whether an owner or operator is fit.

(3) Specific time frames within which the Secretary will determine whether an owner or operator is fit.

(c) Prohibited transportation.--

(1) In general.--Except as provided in section 521(b)(5)(A) and this subsection, an owner or operator who the Secretary determines is not fit may not operate commercial motor vehicles in interstate commerce beginning on the 61st day after the date of such fitness determination and until the Secretary determines such owner or operator is fit.

(2) Owners or operators transporting passengers.--With regard to owners or operators of commercial motor vehicles designed or used to transport passengers, an owner or operator who the Secretary determines is not fit may not operate in interstate commerce beginning on the 46th day after the date of such fitness determination and until the Secretary determines such owner or operator is fit.

(3) Owners or operators transporting hazardous material.--With regard to owners or operators of commercial motor vehicles designed or used to transport hazardous material for which placarding of a motor vehicle is required under regulations prescribed under chapter 51, an owner or operator who the Secretary determines is not fit may not operate in interstate commerce beginning on the 46th day after the date of such fitness determination and until the Secretary determines such owner or operator is fit. A violation of this paragraph by an owner or operator transporting hazardous material shall be considered a violation of chapter 51, and shall be subject to the penalties in sections 5123 and 5124.

(4) Secretary's discretion.--Except for owners or operators described in paragraphs (2) and (3), the Secretary may allow an owner or operator who is not fit to continue operating for an additional 60 days after the 61st day after the date of the Secretary's fitness determination, if the Secretary determines that such owner or operator is making a good faith effort to become fit.

(5) Transportation affecting interstate commerce.--Owners or operators of commercial motor vehicles prohibited from operating in interstate commerce pursuant to paragraphs (1) through (3) of this section may not operate any commercial motor vehicle that affects interstate commerce until the Secretary determines that such owner or operator is fit.

(d) Determination of unfitness by State.--If a State that receives motor carrier safety assistance program funds under section 31102 determines, by applying the standards prescribed by the Secretary under subsection (b), that an owner or operator of a commercial motor vehicle that has its principal place of business in that State and operates in intrastate commerce is unfit under such standards and prohibits the owner or operator from operating such vehicle in the State, the Secretary shall prohibit the owner or operator from operating such vehicle in interstate commerce until the State determines that the owner or operator is fit.

(e) Review of fitness determinations.--

(1) In general.--Not later than 45 days after an unfit owner or operator requests a review, the Secretary shall review such owner's or operator's compliance with those requirements with which the owner or operator failed to comply and resulted in the Secretary determining that the owner or operator was not fit.

(2) Owners or operators transporting passengers.--Not later than 30 days after an unfit owner or operator of commercial motor vehicles designed or used to transport passengers requests a review, the Secretary shall review such owner's or operator's compliance with those requirements with which the owner or operator failed to comply and resulted in the Secretary determining that the owner or operator was not fit.

(3) Owners or operators transporting hazardous material.--Not later than 30 days after an unfit owner or operator of commercial motor vehicles designed or used to transport hazardous material for which placarding of a motor vehicle is required under regulations prescribed under chapter 51, the Secretary shall review such owner's or operator's compliance with those requirements with which the owner or operator failed to comply and resulted in the Secretary determining that the owner or operator was not fit.

(f) Prohibited government use.--A department, agency, or instrumentality of the United States Government may not use to provide any transportation service an owner or operator who the Secretary has determined is not fit until the Secretary determines such owner or operator is fit.

(g) Safety reviews of new operators--

(1) In general.--The Secretary shall require, by regulation, each owner and each operator granted new operating authority, after the date on which section 31148(b) is first implemented, to undergo a safety review within the first 18 months after the owner or operator, as the case may be, begins operations under such authority.

(2) Elements.--In the regulations issued pursuant to paragraph (1), the Secretary shall establish the elements of the safety review, including basic safety management controls. In establishing such elements, the Secretary shall consider their effects on small businesses and shall consider establishing alternate locations where such reviews may be conducted for the convenience of small businesses.

(3) Phase-in of requirement.--The Secretary shall phase in the requirements of paragraph (1) in a manner that takes into account the availability of certified motor carrier safety auditors.

(4) New entrant authority.--Notwithstanding any other provision of this title, any new operating authority granted after the date on which section 31148(b) is first implemented shall be designated as new entrant authority until the safety review required by paragraph (1) is completed.

(5) New entrant audits.--

(A) Grants.--The Secretary may make grants to States and local governments for new entrant motor carrier audits under this subsection without requiring a matching contribution from such States and local governments.

(B) Set aside.--The Secretary shall set aside from amounts made available by section 31104(a) up to $32,000,000 per fiscal year for audits of new entrant motor carriers conducted pursuant to this paragraph.

(C) Determination.--If the Secretary determines that a State or local government is not able to use government employees to conduct new entrant motor carrier audits, the Secretary may use the funds set aside under this paragraph to conduct audits for such State or local governments.

(h) Recognition of Canadian motor carrier safety fitness determinations.--

(1) If an authorized agency of the Canadian federal government or a Canadian Territorial or Provincial government determines, by applying the procedure and standards prescribed by the Secretary under subsection (b) or pursuant to an agreement under paragraph (2), that a Canadian employer is unfit and prohibits the employer from operating a commercial motor vehicle in Canada or any Canadian Province, the Secretary may prohibit the employer from operating such vehicle in interstate and foreign commerce until the authorized Canadian agency determines that the employer is fit.

(2) The Secretary may consult and participate in negotiations with authorized officials of the Canadian federal government or a Canadian Territorial or Provincial government, as necessary, to provide reciprocal recognition of each country's motor carrier safety fitness determinations. An agreement shall provide, to the maximum extent practicable, that each country will follow the procedure and standards prescribed by the Secretary under subsection (b) in making motor carrier safety fitness determinations.

(i) Periodic safety reviews of owners and operators of interstate for-hire commercial motor vehicles designed or used to transport passengers.--

(1) Safety review.--

(A) In general.--The Secretary shall--

(i) determine the safety fitness of each motor carrier of passengers who the Secretary registers under section 13902 or 31134 through a simple and understandable rating system that allows passengers to compare the safety performance of each such motor carrier; and

(ii) assign a safety fitness rating to each such motor carrier.

(B) Applicability.--Subparagraph (A) shall apply--

(i) to any provider of motorcoach services registered with the Administration after the date of enactment of the Motorcoach Enhanced Safety Act of 2012 beginning not later than 2 years after the date of such registration; and

(ii) to any provider of motorcoach services registered with the Administration on or before the date of enactment of that Act beginning not later than 3 years after the date of enactment of that Act.

(2) Periodic review.--The Secretary shall establish, by regulation, a process for monitoring the safety performance of each motor carrier of passengers on a regular basis following the assignment of a safety fitness rating, including progressive intervention to correct unsafe practices.

(3) Enforcement strike forces.--In addition to the enhanced monitoring and enforcement actions required under paragraph (2), the Secretary may organize special enforcement strike forces targeting motor carriers of passengers.

(4) Periodic update of safety fitness rating.--In conducting the safety reviews required under this subsection, the Secretary shall--

(A) reassess the safety fitness rating of each motor carrier of passengers not less frequently than once every 3 years; and

(B) annually assess the safety fitness of certain motor carriers of passengers that serve primarily urban areas with high passenger loads.

MAP-21 REQUIREMENTS FOR A PROFICIENCY EXAMINATION

MAP-21 adds the following two requirements for for-hire new entrant motor carriers.

SEC. 32101. REGISTRATION OF MOTOR CARRIERS.

(a) REGISTRATION REQUIREMENTS.—Section 13902(a)(1) [of 49 U.S.C.] is amended to read as follows:

(1) IN GENERAL.—

…

''(B) has been issued a USDOT number under section 31134;

…

''(D) after the Secretary establishes a written proficiency examination pursuant to section 32101(b) of the Commercial Motor Vehicle Safety Enhancement Act of 2012, has passed the written proficiency examination.''.

(b) WRITTEN PROFICIENCY EXAMINATION.—Not later than 18 months after the date of enactment of this Act, the Secretary shall establish through a rulemaking a written proficiency examination for applicant motor carriers pursuant to section 13902(a)(1)(D) of title 49, United States Code. The written proficiency examination shall test a person's

knowledge of applicable safety regulations, standards, and orders of the Federal Government.

MAP-21 in the immediately following same section makes a conforming amendment to the note to section 31144 that applies to all new entrant motor carriers. It revises the 1999 note from directing the Secretary to consider establishing a proficiency examination and other requirements, to mandating that the Secretary establish such a requirement for all motor carriers.

(c) CONFORMING AMENDMENT.—Section 210(b) of the Motor Carrier Safety Improvement Act of 1999 (49 U.S.C. 31144 note) is amended—

(1) by inserting '', commercial regulations, and provisions of subpart H of part 37 of title 49, Code of Federal Regulations, or successor regulations'' after ''applicable safety regulations''; and

(2) *by striking ''consider the establishment of'' and inserting ''establish''.*

NOTE TO MCSIA SECTION 210(B) – MINIMUM REQUIREMENTS AS AMENDED BY MAP-21

Pub. L. 106-159, title II, Section. 210(b), Dec. 9, 1999, 113 Stat. 1765, as amended by MAP-21 of 2012 (P.L. 112-141), states that:

The Secretary shall initiate a rulemaking to establish minimum requirements for applicant motor carriers, including foreign motor carriers, seeking Federal interstate operating authority to ensure applicant carriers are knowledgeable about applicable Federal motor carrier safety standards.

As part of that rulemaking, the Secretary shall establish a proficiency examination for applicant motor carriers as well as other requirements to ensure such applicants understand applicable safety regulations, commercial regulations, and provisions of subpart H of part 37 of title 49, Code of Federal Regulations, or successor regulations, before being granted operating authority.

The initial 2002 interim and current 2008 final rule implementing the required New Entrant Program, MAP-21 applies the new entrant requirement to all interstate new entrants through the safety registration process of obtaining an interstate USDOT number.

Thus, the conforming amendment to MAP-21 preserves consistency with the existing New Entrant Program in that MAP-21 also requires the proficiency and other requirements be applied to all applicant interstate new entrant motor carriers.

NATIONAL TRANSPORTATION SAFETY BOARD RECOMMENDATION H-12-31

As a component of your new entrant safety audits, review with each new entrant motor carrier a structured process, such as the Safety Management Cycle, to (1) *identify the root cause of safety risks, and (2) maintain an effective safety assurance program.*

APPENDIX C: SUCCESSFULLY FOSTERING A SAFETY CULTURE IN THE LATER SUBGROUPS OF NEW ENTRANT MOTOR CARRIERS

An organization's culture is essentially the underlying philosophy that incorporates shared values and beliefs, therefore guiding decisions and behaviors. A motor carrier's safety culture is the overall structure that incorporates all the norms accepted by that particular carrier. Diffusion theory (applied to new entrants) says there is a distribution of willingness across the population of new entrant carriers to accept and adopt a new idea, like a safety culture, based on varying perceived norms regarding safety practices.

FMCSA is particularly interested in the safety culture concept. TRB Synthesis Report 14[(4)] recommends procedures by which motor carrier safety departments—with support of the company's management—can foster adoption of best safety practices within their companies, thus building and strengthening a corporate safety culture. Many larger established motor carriers have safety departments that are given sufficient resources to facilitate application of such practices within the company. However, the vast majority of new entrant motor carriers cannot afford dedicated safety professionals because they are very small operations. Thus, TRB Synthesis Report 14 concluded with the following question, which the authors referred to as a conundrum:

> Can a safety culture be developed among employees of a small carrier, particularly those carriers not large enough to have a safety department or safety professionals on staff?

New Entrants Fit the TRB Synthesis Report 14 Conundrum

Most new entrants are too small to have a safety department or employ a safety specialist. More than 90 percent are extremely small operations with four power units or less. Very few operate more than 15 power units, and there is internal discussion within FMCSA as to whether such entities really are new entrants. Often new entrants are more of a family undertaking. Initially they tend to expand organically, with the owner hiring siblings, in-laws, cousins, neighbors, friends, etc., to drive.

During the 2005–06 first-generation new entrant training research demonstration, about 99 percent of the control group and 100 percent of the test group reported fewer than 15 power units on their applications for an interstate USDOT number. In both groups, 94 percent of the carriers reported four or fewer power units. Such very small new entrant motor carriers are extremely unlikely to have safety departments or safety professionals on staff. Thus, FMCSA's New Entrant Motor Carrier Program represents a made-to-order laboratory for testing the effectiveness of fostering a safety culture in motor carriers too small to have a safety department or safety professional in staff.

By analyzing collected safety performance measures for the trained new entrants, FMCSA measured the effectiveness of two different curricula for voluntary training and testing interventions as related to fostering adoption of a safety culture and improving safety performance.

The hypothesis for the 2010–12 research demonstration project in Montana was that proactive, early, voluntary training and testing of new entrants would successfully foster adoption of a safety culture by many, thus significantly improving their long-term safety performance. However, even with the more effective second-generation voluntary curriculum, there remained a portion of new entrants that participated in the training that were not convinced to adopt a safety culture.

There is a need for follow-on research to determine how to more successfully convince this residual group to adopt a safety culture. Application of lessons learned from this research (through the MAP-21 requirement that applicant new entrants must, at a minimum, pass a proficiency knowledge test and other requirements before being granted a USDOT number) is expected to give the applicants much more incentive to comply.

Results

The first-generation training curriculum conducted in Montana in 2005–06 included approximately a half day of one-on-one regulatory training with each new entrant. Following the onsite session, there was a recommendation for the new entrants to voluntarily complete follow-up homework (i.e., prepare the recordkeeping files required for the mandatory SA) and submit it for a mock audit review and comment. New entrants also had access to technical support by telephone during the homework period.

Approximately half (117) of the 2005–06 trained new entrants voluntarily completed the suggested homework and submitted it for critique. This process assisted the new entrants in becoming more familiar with the regulatory requirements. While phone calls received for technical assistance were not specifically tracked, the trainer reported that carriers that completed the homework generally also took advantage of the telephone technical support, thus receiving further reinforcement of the initial training.

The remaining half (104) of the trained new entrants decided not to complete the reinforcing homework. Thus, the 2005–06 new entrants that elected to take the training separated into two approximately equal groups: fully trained—or "homework" carriers—and "no-homework" carriers. The safety performance of each group was analyzed separately.

The number of trained new entrants from the 2005–06 research demonstration (221 total) is a small sample. When the number of participants in a group is small, it takes a substantial change in performance to achieve statistical significance. The fact that this small group subdivided into two smaller subgroups meant that the researchers were not optimistic that any change in safety performance (as compared to the control group) would be large enough to be statistically significant.

The 117 new entrant trainees who completed the recommended homework represent those who were successfully convinced by the training to invest their time in a hands-on, reinforcing process. It was surprising to find that the safety performance of the homework new entrants on all measures changed dramatically for the better compared to the control group. The difference was highly statistically significant on all available measures, including:

- Percent of inspections with vehicle violations.
- Percent of inspections with vehicle OOS orders because of the violation.
- Percent of inspections with driver violations.
- Percent of inspections with driver OOS orders because of the violation.
- Carriers' drivers' crash rate.
- Percent of SAs that would have resulted in failure using the pass/fail criteria initiated in April 2011.

In most cases, the statistical significance was at the extremely rigorous 99.9-percent level. Achievement of statistical significance at such a high level with such a small intervention sample on virtually all measurements is an indication of how dramatically the new entrants' safety performance improved.

On all of these measures for both the new entrant control group and for all new entrant motor carriers nationally (not including the homework new entrants referenced above), the new entrants scored substantially worse (at a statistically significant level) than the population of carriers as a whole (a surrogate for experienced motor carriers). This poor safety performance by new entrants is the very reason Congress required creation of the New Entrant Program.

In contrast, performance of the homework new entrant carriers was so much improved by the training and testing (and presumably their adoption of a safety culture) that it was better than the performance of the overall population of experienced motor carriers on most measures. However, most of the differences above the national averages were not statistically significant. The "percent of inspections with vehicle violations" measure was the only one that was statistically significantly better than that of the experienced carriers.

That means that by application of the null hypothesis statistical test, we can say that the safety performance of the 2005–06 homework new entrants is so much improved that it is not statistically distinguishable from that of the surrogate experienced motor carriers. This indicates that even simplistic, early, proactive, voluntary training and testing can raise the safety performance of a portion of the new entrant population.

For the first-generation training curriculum, the roadside inspection safety performance of the no-homework new entrants was generally mixed. It was better than the control group on inspection measures relating to the vehicle and worse on inspection measures relating to drivers. Because of the small population of the no-homework new entrants, the inspection safety performance measurement changes were smaller, and the analysis did not find the performance differences to be statistically significant, even at the less rigorous 95-percent level.

However, it is important to note for reportable crashes that the safety performance even for no-homework new entrants was better than the safety performance of the control group, but only at the 95-percent significance level.

A quote from Sophocles seems applicable to these no-homework interstate new entrant motor carriers, and especially to the precepts of applying e-learning:

> "One must learn by doing the thing, for though you think you know it, you have no certainty until you try." (Sophocles, 400 BC).

A valuable lesson learned from the first-generation training curriculum was that a more effective training and testing intervention was needed to convince the more resistant subgroups of new entrant motor carriers in the population to adopt a safety culture. Thus, the second-generation curriculum for the 2010–12 Montana research demonstration used peers together in a group setting to enable them as part of the instruction and discussions to "convince" each other that it is in their best interest to complete the homework and have it critiqued during a mock audit.

Part of the reason that the second-generation curriculum was initially much more successful than the first is likely due to the fact that the New Entrant Safety Assurance Final Rule, issued December 21, 2008, establishes that the new entrant can fail the SA; plus the new CSA program was just kicking off nationally. These were judged to have created more motivation for new entrants to work with the training and testing. Unfortunately, with the subsequent explosion of economic activity in the oil shale industry in eastern Montana in the latter half of this study, the sheer volume of applicant new entrants contributed to policy reinterpretations that made it much harder to fail the SA, causing the fear of failing to wane. Additionally, the industry realized that small carriers (e.g., most new entrants) are not ranked and thus are not targeted by CSA. These two circumstances had a noticeable impact on the interest level of new entrants that were eligible to participate in the training.

The data indicate that a combination of fears initially made a large impact on new entrants, convincing half of them to participate in the voluntary training. Of those, 85 percent were successfully convinced (most likely by the second-generation curriculum) to complete the homework and (for many of those) to adopt a safety culture. Because of changes in new entrants' perceptions likely caused by changes in external forces, the training participation rate plummeted by the end of the training, but the completion rate of those that decided to participate stayed at the high 85 percent.

Social Diffusion Theory Can Effectively Guide the Process of Fostering Adoption of a Safety Culture by New Entrant Motor Carriers

Diffusion theory asserts that a willingness to adopt new ideas is basically normally distributed across five subgroups: the innovators, the early adopters, the early majority, the late majority, and the laggards. There are a number of components that influence the willingness of each of these subgroups to adopt an idea.

Credit for most clearly articulating this theory of social group behavior initially is widely given to Everett M. Rogers.(21) Subsequently, in a white paper jointly authored with Karyn L. Scott, they gave a succinct summary of the theory as the background, and then in the context of the theory explained how they were going to apply the theory to a practical application.(31)

A similar approach is used here. First, a brief summary of the theory in the context of interstate new entrant motor carriers is presented. The definitions for each of the basic four elements are presented, each followed by discussion of how that element can be applied to guide the Agency as it seeks to foster adoption of a safety culture by new entrant motor carriers. In addition, the first of these basic four elements is further subdivided into five subcomponents.

The high-level definition of diffusion theory presented by Rogers and Scott is:

> Diffusion is the process by which (1) an innovation [or idea] (2) is communicated through certain channels (3) over time (4) among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas.

The following observation by R. Raul Roman is especially important for the most resistant subgroup, identified as the laggards:

> The focus of the theory is not only on awareness and knowledge but also on attitude change and the decision-making process that lead to the practice or adoption of the innovation.[32]

First Basic Element: The Innovation or Idea

<u>Definition</u>

FMCSA wants new entrant motor carriers to adopt a safety culture—this is the innovation or idea in question. The characteristics (or subcomponents) of this idea determine the rate of adoption. The subcomponents include:

- Relative Advantage.
- Compatibility.
- Complexity.
- Trialability.
- Observability.

1. **Relative Advantage**. This is the degree to which the idea in question is perceived as better than the idea it would replace. The degree of relative advantage may be measured in economic terms, but social prestige, convenience, and satisfaction are also important factors. It does not matter so much if an idea has a great deal of objective advantage. What matters is whether the new entrant perceives the idea as advantageous. The greater the perceived relative advantage of the idea, the more rapid its rate of adoption will be. This means new entrant motor carriers have to understand the idea in order to knowledgably perceive its relative advantage.

2. **Compatibility.** This is the degree to which an idea is perceived as being consistent with the existing values, past experiences, needs, and norms of the new entrant. An idea that is perceived as incompatible with the values and norms of the new entrant's pre-existing social system is less likely to be adopted as rapidly as an idea that is perceived as compatible. The adoption of an idea that is perceived as incompatible with the existing norms often first requires convincing the new entrant to adopt a new norm value system. This appears to be the case with the very resistant

laggard subgroup. Without significant external pressure, such as a mandatory requirement, adoption of new norms or perceptions of the new idea is usually a relatively slower process as you move to the increasingly resistant subgroups, and the very resistant may never adopt the idea.

3. **Complexity.** This is the degree to which an idea is perceived as difficult to understand or use. Some ideas are readily understood; others are more complicated and thus will be adopted more slowly. New ideas that are simpler to understand, or are clearly explained via training, are more likely to be adopted more rapidly than ideas that require the development of new skills or knowledge without clear detailed support.

4. **Trialability.** This is the degree to which an idea may be experimented with on a limited basis. New ideas that can be tried on the installment plan will generally be adopted more quickly than ideas that are not divisible. An idea that is "trialable" represents less uncertainty to the individual who is considering it for adoption. It offers the option of learning by incrementally doing (i.e., trying it out) and later dropping or discontinuing the adoption if it does not fit the individual's needs or expectations.

5. **Observability.** This is the degree to which the results of an idea are visible. The easier it is for individuals to see results of an idea, the more likely they are to adopt it. Such visibility stimulates peer discussion of the new idea. Friends and neighbors who have already adopted an idea are often asked by their peers to give an evaluation of the idea, because they have already tried it out.

<u>Implications for Adoption of a Safety Culture</u>

What insights do the above-listed subcomponents of this basic element (the innovation or idea) offer for designing new entrant training? In the case of new entrant motor carriers, the idea being advocated is that new entrants' survival would be better served if they adopted a safety culture as the philosophy guiding their daily operating practices. It is critical to convince new entrants that adopting a safety culture is in their best interest. This can be accomplished by swaying new entrants' perceptions of safety as related to the above five subcomponents, as their perceptions will shape their willingness to adopt a safety culture. Following is a discussion of how the training and testing curriculum should address each of these five subcomponents:

1. Relative Advantage. New entrants that have no experience base or understanding of the importance of safety as part of daily operational practices commonly will perceive such a concept as an imposed extra cost that would counter profits. Thus, we see the importance of a training process which makes the case that although following safety practices does take time and money, if the new entrant does not incorporate them as a part of operational activities, then in the long run they are more likely to incur even greater costs (resulting from FMCSA's regulatory enforcement and liability losses caused by crashes) the latter of which could put them out of business. The importance of training is to clearly show that the increased operating costs for applying daily safety practices are really an investment that pays dividends over time. The laggards do not perceive the idea of a safety culture as having any relevance to them and are very resistant to changing that perception. The safety benefits realized by the others who have adopted a safety culture could be emphasized as part of the training to provide concrete illustrations of the value to them. For example, the data from both the first- and second-generation training show that a higher percentage of new entrants that adopted a safety culture remained in business. The second-generation results also showed that the new entrants who adopted a safety culture also grew the fastest.

2. **Compatibility.** If a new entrant has no experience with following daily safety practices, that new entrant may view the adoption of a safety culture as incompatible with the current value system or norms. In deciding whether an idea is compatible with their existing values, perceptions (for many) may be influenced by attitudes passed on by opinion leaders or other individuals within their peer groups. Thus, during training, opinion leaders need to communicate with other new entrants that many of their successful peers decided that adoption of a safety culture is a logical and productive approach. Sharing this type of information about peers can positively influence more of the resistant new entrants to more seriously and more quickly consider adopting a safety culture. By approaching the more reluctant new entrants as a group to change the group perception of their norms, it may be more possible to influence individual new entrants within that subgroup to adopt a safety culture. However, the laggards tend to be unresponsive to opinion leaders and peers. In their case, the training focus may need to be first on modifying their individual perceived norms before they become receptive to ideas from opinion leaders and peers.

3. **Complexity.** FMCSA's safety regulations are highly detailed, requiring considerable expenditure of energy and/or resources to master. If this barrier is not addressed via thorough, clear training, it will significantly impede adoption of a safety culture by the more resistant new entrants. Although there are many regulations, it is important that the training make it as simple as possible for carriers to understand the requirements of each regulation. The simpler the explanation for each regulatory requirement, the less complex and more manageable the new entrant perceives the subject to be. Then, learning the regulations one at a time becomes relatively easier. This is why it is recommended that the third-generation curriculum include computer-assisted training as part of a self-paced, blended program. A visual, computer-based module will be able to present ideas at a clear, simplistic level, and the new entrant can review the content as many times as needed, for as long as needed.

4. **Trialability.** While it is quite possible for a new entrant to implement a safety culture in small increments and "try it out" for a trial period, a new entrant that does this will still be more vulnerable to enforcement and/or crash liability problems in the areas where they have yet to implement safety practices. Also, it probably is not in any new entrant's best interest to advocate that there is an option to discontinue application of best safety practices after a trial period. However, it is observed that such discontinuance does occur. It is common for a motor carrier without a business plan or any understanding of finances to come into financial difficulty and thus discontinue safety practices. The subgroup most likely to discontinue using an idea after adopting it is the same group that is the hardest to convince—the laggards. By the time new entrants in this category finally go out of business, they have already spent a considerable amount of time operating as very high safety risk carriers.

Addressing the poor safety performance that results from discontinuance of safety practices is one of the functions of enforcement. Part of what enforcement does to influence behavior modification is point out the peril of such a decision to any new entrants that are found to have poor safety performance, either because of not adopting or discontinuing application of best safety practices. Enforcement actions will hopefully point out to motor carriers that fail to adopt (or discontinue practice of) a safety culture that such an approach to daily operations is not in their best interest. Both the New Entrant Program and CSA interventions are intended to provide such high-risk new entrants with "encouragement" to seriously consider adopting and practicing a safety culture.

5. **Observability.** To demonstrate that there are tangible benefits to adopting a safety culture, any current or subsequent training should highlight the safety performance results found during analysis of the 2005–06 and 2010–12 training demonstrations. The concept of "observability" ties in closely with the concept of "relative advantage," as explained above. The new entrant motor carriers that participated in the training demonstrations, completed the recommended homework, and embraced a safety culture ultimately realized a dramatic reduction in safety-related problems. Their better safety performance meant fewer OOS orders and directly translated into less intervention by FMCSA under both the new entrant and CSA enforcement programs. The improved crash performance translated into fewer losses from crash liability, thus preventing increases in insurance rates and diminishing the threat of a new entrant being put out of business by court awards for crashes that exceed insurance coverage limits. During training, this should be emphasized as part of the group discussions in order to encourage shared peer perception of the observed value of adopting a safety culture.

Second Basic Element: Communication Channels

<u>Definition</u>

Communication is the process by which participants create and share information with one another in order to reach a mutual understanding that the idea is something they want to adopt. Communication channels can be anything, e.g., mass media communication, group training classes, one-on-one training discussions, computer-aided training, Web sites, or some combination of these.

Mass media channels are more effective in communicating knowledge about the existence of a new idea or practice, but they are not effective in convincing resistant new entrants to adopt an idea—in this case a safety culture. Unlike mass media channels or information posted on FMCSA's Web site, direct personal training channels are more effective in forming and changing attitudes about the value of the idea, and thus in influencing the decision of the new entrant motor carrier to adopt or reject a safety culture.

Diffusion theory predicts that face-to-face training and communication among individuals of the same socioeconomic status and educational level are more likely than mass media to increase the potential of acceptance. For example, an instructor who is viewed by the new entrants as similar to them and knowledgeable about their working environment will be more convincing about the effectiveness of adopting a safety culture than announcements on the national news.

The majority of new entrant motor carriers will be more influenced by conversations with their peers than by publications, trade and scientific associations, or information posted on FMCSA's Web site. Although such sources provide an abundance of information, including information about the effectiveness and benefits of motor carriers adopting a safety culture, they are not an effective means of reaching and convincing new entrants to adopt a safety culture. This is especially true for the more resistant last two subgroups of new entrants that do not seek out such information. Not even the early majority seeks out new information. It must be brought to them, and doing so through training and testing would be especially effective.

Implications for Adoption of a Safety Culture

Analysis of the safety performance statistics of new entrants from the second-generation curriculum research demonstration provided information on the effectiveness of the enhancements, including group interactions, applied in that curriculum.

Building on Diffusion Theory's observation of the importance of opinion leaders and peers working within groups, the following was added to the 2010–12 second-generation curriculum:

- Official outreach to validate the new entrants by the training and testing organization. The goal was to establish a personal relationship that would lessen resistance caused by the flood of solicitation phone calls that new entrants receive from vendors trying to sell them services immediately after activation of their interstate USDOT number.
- A required signed agreement by participants that they would complete the full training, including preparation and a subsequent critique of the recordkeeping files that had originally been optional in the first-generation curriculum.
- Use of a group peer-training session.
- Use of a motivational video with multiple external community opinion leaders explaining the importance of a safety culture to survival of the new entrant.
- Participation by other partner opinion leaders, including business executives via the Service Corps of Retired Executives (SCORE).
- Local publicity outreach on community cable channels.
- A one-on-one follow-up contact with a SCORE mentor for business training.
- A second one-on-one contact as a follow-up mock audit reviewing the recordkeeping materials prepared as homework.
- Structured advice on trade associations (which would encourage information sharing related to safety best practices). The Peer Review Committee for the 2010–12 research project suggested advocating that new entrants participate in available trade associations in order to gain peer interactions.

Use of a group peer-training session is a modification from the 2005–06 first-generation training curriculum, which did not use groups. The 2005–06 training curriculum had one contact and exclusively used one-on-one, face-to-face interaction as the delivery method for training. As predicted by Diffusion Theory, that method achieved communication among local Montana individuals of roughly the same socioeconomic status and educational level, therefore achieving considerable acceptance of the information being presented and the concept that the new entrants should adopt a safety culture.

However, the lack of peer reinforcement resulted in a limited ability to convince the more resistant participating new entrants to adopt a safety culture. The implications of adding the group training interactions and additional reinforcing contacts and a review of how the second-generation research demonstration incorporated both are discussed in more detail below.

The surrogate indicator of success in convincing the first-generation trained new entrants to adopt a safety culture is represented by slightly more than 50 percent of the 2005–06 new entrants who voluntarily chose to attend the training, then chose to complete the recommended homework on their own. Based on this indicator, we found that the safety performance and crash data associated with the homework group showed dramatic improvement, corroborating that they were convinced to adopt a safety culture. We found a similar correlation with the 2010-2012 training.

A goal of this examination of diffusion theory is to identify what additional interventions not included in the second-generation curriculum research demonstration should be considered for the third-generation curriculum in order to more effectively convince the most resistant new entrants to adopt a safety culture.

For example, computer-assisted learning is recommended to help provide more detailed knowledge training and testing for the complicated regulations as part of the third-generation blended curriculum. Such computer-based training and testing can more effectively communicate regulations to the new entrants at their own pace, and can provide more concrete examples and exercises.

Third Basic Element: Length of Time Required to Adopt an Idea

Definition

The propensity of the five subgroups across a population to adopt new ideas is represented over time as a normal distribution. The goal in the case of training and testing new entrant motor carriers is for the intervention to convince them to adopt a safety culture. The goal of the intervention is to significantly compress the amount of time required for new entrants to come to an understanding that it is a good idea to adopt a safety culture. The most difficult to convince will be the most resistant subgroup, the laggards. This distribution of subgroups is illustrated in Figure 11.

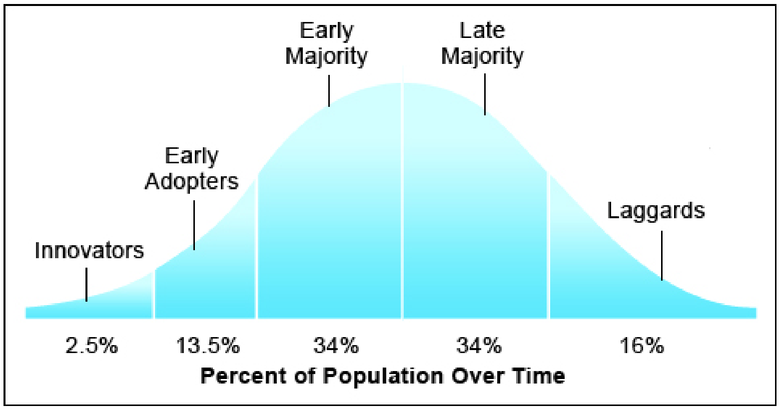

Figure 11. Diagram. Innovation Adoption Lifecycle.
Adapted from: http://en.wikipedia.org/wiki/Technology_adoption_lifecycle.

Adoption of a safety culture by this distribution over time can be depicted as the cumulative S-shaped curve, as shown in Figure 12. It illustrates what percentage of the population (made up of the five subgroups) that, over time, adopts the idea of a safety culture. This curve illustrates the cumulative but decreasing propensity for the successive subgroups to adopt a new idea. The goal of the training and testing is to compress the S-curve into as short a time as possible. The flattening out of the curve near the end clearly illustrates how much more time and/or level of intervention are required to convince the last subgroup, the laggards, to adopt a safety culture.

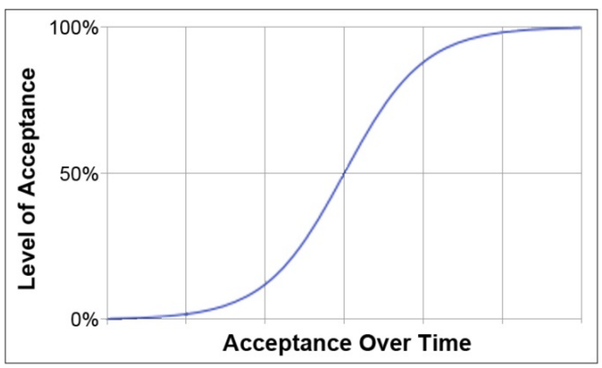

Figure 12. Graph. Cumulative adoption by new entrants.
Adapted from: http://en.wikipedia.org/wiki/Logistic_function.

The following definitions are assembled as paraphrases from a number of sources, which all contribute to the definitions put forth in Rogers' and Scott's paper.[(33)] The dimension of time indicates when each group of adopters is more likely within the diffusion process to accept and adopt the idea. Although the S-curve will always be the pattern describing the rate of adoption, there can be significant differences in how steep and compressed in time the curve may be regarding how quickly the idea of a safety culture is adopted. The rate of adoption depends on a variety of variables articulated in the theory, including how effectively the concept of a safety culture is communicated via training.

- The first subgroup of adopters is the innovators. This subgroup is estimated to comprise approximately 2.5 percent of the population. The innovators are the risk takers and pioneers who tend to go looking for new information, and thus lead the way. They generally have the most resources and do not need to worry if the effort to adopt the idea does not work out. They generally have the ability to understand and apply complex technical knowledge and can cope with a high degree of uncertainty about an innovation.

- The second subgroup is the early adopters. This subgroup is estimated to comprise approximately 13.5 percent of the population. The early adopters are an integrated part of the local social system, have the greatest degree of opinion leadership, are respected by their peers, and are successful. They are very likely to quickly embrace new ideas and thus, together with the first group, can form a critical mass to help spread the word about the idea to others. Advertising campaigns, which are dealing with voluntary choices, have initially focused on the innovators and early adopters to leverage them to help convince the next group, the early majority.
- The third subgroup is the early majority. This subgroup is estimated to comprise approximately 34 percent of the population. The early majority generally is reasonably accepting of clearly articulated new practices, if they make sense to them. Unlike the previous two subgroups, they are not inclined to go looking for such information; it must be brought to them, for example through training of new entrants. They interact frequently with peers and carefully deliberate new ideas before implementing them.
- The fourth subgroup is the late majority. This subgroup, like the early majority, is estimated to comprise 34 percent of the population. The late majority tends to adopt new practices after the first half of the population. Without intervention, acceptance is more likely to result from the increasing pressures from peers with whom they network. If we want to compress the time required for this diffusion, training is an effective intervention. New practices are approached by the late majority with a skeptical and cautious air. This subgroup tends not to adopt a new practice until many others in their system have done so, and it is effectively communicated to them that the idea is sound and workable. The weight of this subgroup's norms must come to favor adoption of the new practice before the late majority will be convinced to do so. The pressure of peers is critical to motivate adoption. This subgroup also tends to have less discretionary resources to analyze new ideas or practices (i.e., its members often are of a less-well-off socioeconomic subgroup). Their relatively scarce resources mean that most of the uncertainty about a new practice must be removed before they feel it is safe to adopt.
- The final subgroup is the laggards. This subgroup is estimated to comprise approximately 16 percent of the population. The laggards possess almost no leadership for new ideas, no ability to analyze the value of new ideas or practices, and tend to be socially insulated. Laggards are the most inward-looking of all subgroups, to the point of being near-isolationists in their social networks. The point of reference for the laggard is the past, i.e., their existing norms or what has been done previously. Laggards tend to be suspicious of new ideas and external change agents. Laggards' resistance to ideas likely seems entirely rational to them, as their resources are limited and they must be certain that a new idea will not fail before they can risk adopting it. Persons who might function as opinion leaders or exert peer pressure will be ejected from the group if they advocate a new idea that deviates from the group's perceived inward-looking norms.

Implications for Adoption of a Safety Culture

The first two subgroups are much easier to convince. The first-generation curriculum demonstrated the power of training to convince some individuals. Because data on participation was not kept in the first-generation training, we do not know the distribution of the five subgroups (i.e., which chose to participate in the training and which declined.) Just as with the second-generation training, the training was voluntary. Thus, it was unlikely the late majority and laggards chose to participate, and even unlikely the early majority participated.

We know the first-generation training curriculum convinced slightly more than 50 percent of the those that chose to be trainees to adopt a safety culture. We know that the second-generation curriculum always convinced at least 85 percent of those that chose to be trainees (in some calendar quarters more than that) to adopt a safety culture. This theory predicted that because the second-generation curriculum included opportunities for peers to influence peers, it was expected to successfully convince a higher percentage of the participating trainees.

The theory also describes how to influence new entrants to more quickly adopt a safety culture. Namely, the higher the level of interaction within the new entrant community in communicating the importance of the FMCSA regulations (such as via mandated training and testing) the less time will be needed to convince the more resistant new entrants to adopt a safety culture. The MAP-21-mandated new entrant actions will be a strong intervention that should enable compressing the rate of adoption via a mandatory training and testing program. Such an intervention was authorized by MCSIA Section 210(b) and now is mandated by MAP-21.

However, compressing the time is an unlikely dimension for influencing whether the laggards adopt a safety culture. This theory also identifies why the laggards are the most difficult to convince to adopt a safety culture. In the context of using voluntary early training and testing, the challenge was how to more effectively convince the resistant groups that it is in their best interest to adopt a safety culture. The external change agents (which could be the trainers) along with the peers in the class, or some other norm-modifying training intervention, must convince this very resistant subgroup that a safety culture is compatible with their inward-looking norms, such as getting their USDOT number, passing the recommended post-training audit, and business survival/growth. The MAP-21 mandate will assist in the process.

It is important to be aware that some members of the laggard subgroup may never be convinced by the training and testing program alone, even though forced by the MAP-21 mandate. Some of these will be addressed by failing the training and proficiency test, thus denying them an interstate USDOT number. Some of these will pass the test and begin operating. These higher-risk new entrants will have to be addressed by more focused identification and enforcement intervention, which could lead to them being placed OOS or even by having their USDOT number rescinded.

Fourth Basic Element: the Social System

Definition

The social system includes influences from economic circumstances, social network cooperation, power relations, government policies, competition/cooperation, standardization, and now the

Internet and social media. Individual interstate new entrants, other than perhaps the innovators, are unlikely to adopt a safety culture in isolation of what is happening in the overall new entrant motor carrier industry. Successfully convincing the subgroups to adopt a safety culture will be largely influenced by external change agents, internal opinion leaders within that group, by the norms of the subgroups, and what will become industry practices, which are now mandated by MAP-21.

Implications for Adoption of a Safety Culture

The lack of opinion leaders or even the acceptance of such in the laggard group means there are no easy ways to foster adoption of ideas, which is why this subgroup is so resistant. They also may be limited users of alternative communications channels, such as social media. That is why it is so important to consider other training approaches to address and modify their perceived norms about the value of a safety culture.

The late majority and laggard subgroups demonstrate why it is so valuable for the training to include peer group sessions, which were used in the 2010–12 second-generation curriculum and are included in the third-generation training and testing curriculum recommendation put forth in this report.

By using such peer groups, there is a better chance of getting some functional opinion leaders in the group. While opinion leaders will more likely be from the early adopters subgroup, or perhaps early majority, all the members of the class have a commonality in that they are all trying to enter the interstate motor carrier business, and they have mandates to cope with as they strive to pass the training and testing (which should include the equivalent of the current SA) to obtain an interstate USDOT number and subsequently minimize problems with enforcement and better ensure business survival. Thus, there is a possibility of more commonality than assumed by diffusion theory.

An important implication of diffusion theory is that the more resistant new entrants are less likely to adopt a safety culture, as they are often isolated from what is happening in the overall new entrant motor carrier industry. The MAP-21 mandate for a proficiency knowledge test and other requirements to ensure they understand the regulations is a critical new intervention for establishing an industry-wide new entrant environment where training and testing is universally mandated.

What would it take to convince the more resistant new entrants to want to adopt a safety culture, and thus come to an understanding of FMCSA's requirements?

In order to substantially raise the success rate for adopting a safety culture by the late majority and laggard subgroups, additional motivational factors are going to have to be communicated via training interactions. The interventions incorporated in the second-generation curriculum built on lessons learned, both from analysis of data from the 2005–06 training and from what diffusion theory predicts. That curriculum, with the addition of peer interactions and other interventions to motivate them, successfully influenced a substantially larger portion of the voluntarily training group to adopt a safety culture.

The second-generation curriculum still did not convince the entire training group to adopt a safety culture. These results provide important insights as to the additional communication training and motivational interventions needed to convince the more resistant new entrants to adopt a safety culture and to achieve an understanding of FMCSA's requirements.

For example, the second-generation training curriculum used a group instructional session with discussion to achieve peer sharing about the concepts and benefits of adopting a safety culture. One of the benefits of adopting a safety culture seen in the first-generation training is the improvement in safety performance and crash rates achieved by new entrants that voluntarily completed the homework. The second-generation training showed a clearly better survival rate and better growth rate for those that adopted a safety culture. Those results can be used as a demonstration to other new entrants that adoption of a safety culture is in their best interest. For the second-generation training, a motivational video was added that features a number of peers and industry opinion leaders discussing the importance of adopting a safety culture and letting it guide operational decisions to ensure business survival.

Another example of communications added in the second-generation curriculum was inclusion of interaction with business mentors from SCORE. This interaction provided the new entrants hands-on, basic knowledge of running a business and developing a business plan. Interaction with a SCORE mentor reinforced the importance of business practices for survival. By teaching a new entrant carrier how to develop a business plan, estimate costs, project revenue streams and avoid financial distress, it will avoid scenarios where carriers skimp on safety requirements to avoid extra costs and ultimately end up out of business. Statistically, new entrant carriers that have gone out of business have had a poor safety record. Thus, it is important that new entrant motor carriers have basic business knowledge, in order to promote safe operations from the start.

Studies in the past found there is a multiplier effect when communication via education is combined with enforcement. Initially we saw a similar multiplier effect with the second-generation research demonstration project. That waned when it became perceived that the enforcement was less of a threat than initially perceived.

MAP-21 now requires FMCSA to implement a new entrant proficiency knowledge test and other requirements to ensure that new entrants understand FMCSA requirements before being issued an interstate USDOT number.

The quote by Rogers in his seminal book points out the importance of such social structures in influencing adoption of an idea such as adopting a safety culture by new entrants:

> This dependence on the experience of near peers suggests that the heart of the diffusion process consists of modeling and imitation by potential adopters of their network partners who have adopted previously. So diffusion is a very social process.[(34)]

There are areas where the existing networks of internal opinion leadership can be better leveraged through training to informally influence new entrants' attitudes. The role of external change agents (e.g., trade associations) in cooperation with individual internal opinion leaders is something of interest and may have a powerful impact on FMCSA's efforts to promote adoption of a safety culture. For example, the trucking associations in each State are a possible resource that could be better utilized to increase new entrants' decisions to adopt a safety culture. Also, national implementation of a training and testing program would expand the number of persons actively involved as change agents and hopefully would also increase the number of new entrants and other motor carriers involved in opinion leadership.

There is already a network of individuals engaged as change agents through enforcement processes (i.e., performing roadside inspections that serve as the data source for targeting problem carriers for additional attention). Theory predicts that the addition of positive change agents as trainers and testers (and hopefully more opinion leaders) would have a multiplier impact on the effectiveness of new entrants adopting a safety culture.

APPENDIX D: CRITERIA FOR SELECTION OF REPRESENTATIVE NEW ENTRANTS INCLUDED IN CONTROL GROUP

Determination of statistical significance of a change brought about by training was made by comparing measures of trained Montana new entrant motor carriers' safety performance to the same measures of a representative control group. This appendix describes criteria used for determining selection of the representative control group, and the logic applied to determine the criteria.

Four major considerations—timeframe, geography, carrier type, and carrier size—were applied to select a representative control group.

However, even after selection of States for the control group, additional analysis was performed to validate that there were no other differences between the control group and the trained groups that might affect the results.

This appendix explains the analysis that was used to select the control group for the initial analysis of the impact of training for the 2005–06 training period. It then explains the minor changes that were made in the selection criteria for the second control group, selected as a part of the analysis of the 2010 – 2012 training.

CONSIDERATIONS IN CONTROL GROUP SELECTION

Consideration—Time Frame

Prior studies observed that motor carrier safety data patterns change from year to year. For example, FMCSA has an ongoing program to improve data quality of reported crashes, and promote reporting of all "reportable" crashes.

FMCSA's crash data quality program successfully increased the percentage of crashes reported and the quality of the data.[35] For example, the methodology used for FMCSA's unpublished 2008 New Entrant Program Effectiveness Study[36] had difficulty meaningfully comparing crash rates over time because they changed over the time interval included in the study for reasons other than the New Entrant Program. Such changes in reported crash data are independent of safety performance changes brought about by the intervention training intended to make new entrants operate more safely.

Similarly, over time there are changes in safety performance results from the inspection program. Table 40 shows the cumulative impact of the MCSAP program on industry performance as the changing percent of inspections that result in violations issued over time, as well as the changes in percent of inspections that result in OOS orders over time.

Thus it was decided that the comparison for effectiveness of the training intervention could not be made reliably using a before-and-after study. This is because if the control group was chosen with different new entrant entry dates from trained new entrants, their inspection result patterns likely would differ based on earlier years of entry.

Table 40. Patterns of assignment of violations and OOS orders change over time.

Year	Percent of Inspections With at Least One Assigned Violation	Percent of Inspections With at Least One OOS Order
2004	73.15%	23.29%
2005	72.82%	22.53%
2006	71.80%	22.41%
2007	69.71%	21.31%
2008	68.35%	20.57%
2009	66.60%	19.22%

There also is a trend, or learning curve, occurring in the industry. Information from those trends is available to most new entrants. Thus, on average, new entrants in earlier years had more inspections that resulted in violations, and more inspections that resulted in OOS orders, because different levels of industry learning were driving rates at those different entrant dates. Similarly, on average, new entrants in later years had fewer inspections that result in violations and fewer inspections that result in OOS orders.

Therefore, because of these ongoing changes in data quality, quantity of reporting, and overall performance of the industry, it was decided that this analysis would compare safety performance for groups in the same time periods. The control group was selected from new entrants that had an MCS-150 “Add Date” that matches the timeframe of MCS-150 “Add Dates” of the Montana trained intervention group. Specifically, for analysis of the first-generation curriculum, new entrants in the control group had “Add Dates” between December 1, 2004, and July 31, 2006.

Consideration—Geography

There are a number of reasons why regional differences among carriers’ safety performance are expected. For example:

- There are cultural differences (e.g., urban versus rural) in both carrier activities and carrier practices.
- There are differences in the nature of dominant motor carrier businesses in different regions of the country. For example, there are probably relatively few log or oil rig haulers in Connecticut, but there are many in the western States around Montana.

For this reason, only States geographically similar to Montana were selected in the control group. Additionally, only States with somewhat similar population densities were included in the control group.

There are four States neighboring Montana: Idaho, Wyoming, North Dakota, and South Dakota. Each of these States has a population density similar to Montana’s, so new entrant carriers from these States were included in the control group.

There are eight additional States near Montana. These States, listed in increasing order of population density are: Nevada, Nebraska, Utah, Oregon, Colorado, Iowa, Minnesota, and Washington.

- The two most distant States are Iowa and Minnesota, which could contribute to larger regional differences. Additionally, those States also have the second- and third-highest population densities on the list. So, those two States were excluded from the control group.
- Unlike Iowa and Minnesota, Washington State is fairly close to Montana. At the closest point it is approximately 100 miles away from Montana. However, there is a substantial difference in population density. Washington has almost 15 times the population density of Montana. Therefore, Washington was also excluded from the control group.

As a result, the following nine States satisfy the criteria of being located in a similar geographical area and having roughly compatible population densities:

- Colorado.
- Idaho.
- Nebraska.
- Nevada.
- North Dakota.
- Oregon.
- South Dakota.
- Utah.
- Wyoming.

Consideration—Carrier Type

Training was offered only to new entrants (based in Montana) that were engaged in interstate commerce. However, because many States are PRISM States, there were a number of new entrants in the control States that registered for USDOT numbers and planned to operate intrastate. Thus a considerable portion of new “Add Dates” for new entrants in the identified control group States were intrastate carriers, with no hint that they would ever engage in interstate commerce. Such intrastate carriers do not qualify for the New Entrant Program and were excluded from the control group.

A review of the 2005-06 trained new entrants in Montana showed that about 8 percent (18 new entrants) had initially planned to be intrastate carriers, as marked on their initial MCS-150 forms. But these new entrants had gone through the first-generation training, and their census data had changed by the end of 2006 to show that they were interstate carriers. In order to match the experience of the trained new entrants in Montana (in addition to the other constraints described), the control group was selected to include:

- Carriers that filed as interstate in their initial MCS-150, and were later validated to be interstate (a total of 6,251 carriers).
- Carriers that filed as intrastate carriers in their initial MCS-150, but had become interstate carriers by the end of 2006 (183 carriers).

In summary, all interstate new entrants from the identified control group States with MCS-150 "Add Dates" in the identified timeframe (except those excluded by the carrier size criteria described below) were included in the control group.

Consideration—Carrier Size

Carrier size must be considered because the underlying concern of the 2010-12 research is to determine whether new entrant motor carriers that are too small to have a safety department or safety professional on staff (i.e., most new entrants) can be successfully convinced, via proactive training, to adopt a safety culture. Further, it was a specific goal in development of the control group that new entrants in the control group should be relatively similar to the trained Montana new entrant carriers.

All the trained new entrants in Montana had 15 or fewer power units. A review of the control group data revealed that some likely were associated with large corporate structures. About 1 percent of new entrants in the control States reported substantial numbers of power units. Higher numbers of power units could imply that these carriers may be large enough to have a safety department or at least a safety professional on staff. Separately, there could have been a problem in the data reported.

Initially, researchers examined the data to determine whether there was a reasonable break point, but there was not. Table 41 shows the number of new entrants and the number of power units reported by the new entrants, grouped by number of power units.

Table 41. Number of power units.

Group	Montana Trained Carriers—Number of Carriers	Montana Trained Carriers—Reported Power Units	Considered Control Group—Number of Carriers	Considered Control Group—Number of Reported Power Units
No Reported Power Units	2[a]	2	102	102
1 Reported Power Unit	158	158	4,573	4,573
2–4 Reported Power Units	47	115	1,418	3550
5–9 Reported Power Units	11	67	248	1477
10–15 Reported Power Units	3	41	75	896
More Than 15 Reported Power Units	N/A	N/A	87[b]	3,567

a) Researchers assumed one power unit per carrier when the carrier reported zero power units.

b) Data for 4 carriers that reported a total of 5 drivers and 14,002 power units on their initial MCS-150 were excluded from this table because there were clearly problems with the data.

As shown in Table 41 above, all first-generation Montana trained new entrants reported fewer than 16 power units on their initial MCS-150 forms. In both the trained and the control groups, 94 percent of new entrants reported four or fewer power units.

However, in the control group, there would have been 87 new entrants (slightly more than 1 percent of the total) that would have had more than one-fourth of the reported power units. Further, a review of the data showed that these new entrants had counts of inspections and crashes that were appropriate for new entrants of their reported size.

Because no trained new entrants in Montana reported more than 15 power units on their MCS-150 forms, and because of the stark differences in the potential impact that the limited number of large new entrant carriers would have on the data, the size dividing line was established as new entrants reporting 15 or fewer power units on their initial MCS-150 forms.

New entrant motor carriers that reported 16 or more power units were excluded from the control group. All other new entrant motor carriers that were from the above-listed nine States and met the carrier type and timeframe constraints were included in the control group.

Consideration—Remaining Issues

A number of other issues were considered as possibilities that could affect the validity of the control group. However, after those issues were analyzed, it was decided to make no adjustments to the control group based on these considerations.

Size of Motor Carrier

Some consideration was given to analyzing differences between very small new entrants (4 or fewer reported power units) and small new entrants (5–15 reported power units.) However, the data were so sparse that the results were statistically meaningless and thus abandoned.

Private versus For-hire

The question arose as to whether the distinction between private and for-hire carriers might affect the difference between performance of trained new entrants and the control group in Montana. The researchers performed a statistical analysis of private versus for-hire carriers and there was no statistically significant difference between them.

High Ratio of Inspections to Reported Power Units

In looking for anomalies in control group new entrants, some consideration was given to removing new entrants with a high ratio of inspections to reported power units. We reviewed the 58 new entrants that had more than 50 inspections per power unit (from January 1, 2006 to the time of data cutoff—a period of slightly more than 3.5 years, or approximately 14.3 inspections per power unit per year), based on the number of power units indicated on the initial MCS-150. The review found:

- Fifty-three of the 58 new entrants filed subsequent MCS-150 forms and increased the number of reported power units. In all but 3 cases, the new entrant still had fewer than 16 power units. The total number of inspections for these new entrants was not out of line with the total number of inspections of other carriers that had fewer than 16 power units.

- Five new entrants had not updated the number of power units by 2008. All five of these new entrants had reported one power unit on their initial MCS-150. These new entrants had a total of 65, 60, 59, 58, and 54 inspections. However from the inspection data they had a total of 14, 11, 13, 20, and 19 different DLNs associated with their inspections. Among the five new entrants, all but four of the DLNs were properly formatted. Clearly these new entrants were running more than one power unit, and thus had an appropriate number of inspections per driver.

Further, there was no clear cut-off point; there were also plenty of new entrants with between 30 and 50 total inspections per reported power unit for the time period in question. This is between 8.5 and 14.3 inspections per power unit over the 3.5-year period.

Consequently, no new entrants were eliminated from the control group based on the ratio of inspections to power units.

High Ratio of Drivers per Power Unit

The second filter considered was eliminating carriers that reported more than five drivers per power unit. There were 60 new entrants in the control group that reported at least 1 power unit, less than 16 power units, and more than 5 drivers per power unit. Of these 60 new entrants, only 41 had any inspections; 36 had between 1 and 10 inspections, and 6 had between 11 and 16 inspections. One new entrant had 57 inspections, and another had 70 inspections.

- The new entrant that had 57 inspections had inspections on 26 different drivers. This new entrant reported 5 power units and 37 drivers.
- The new entrant that had 70 inspections had inspections on 23 different drivers. The census data on file for this new entrant was one power unit and six drivers.

There were also four new entrants that reported no power units (in 2006) and reported more than five drivers. Of these, three had inspections, and one had no inspections. Of the three with inspections:

- One had one inspection.
- One had two inspections.
- One had 67 inspections. This new entrant reported 16 drivers on their initial MCS-150. This new entrant's 2008 census showed seven power units and seven drivers.

The statistics suggest that these were primarily new entrants that misreported their number of drivers. Even those very few that apparently actually had a large number of drivers had data in line with other new entrants in the control group. All other statistics point to these new entrants as being small carriers, well within the definition of this study. Thus, new entrants with a high ratio of drivers to power units were not excluded from the control group.

An important point concerning the number of drivers reported by the new entrant motor carrier is that other than the comparison just described here, no analysis was performed on the number of drivers reported by carriers. Instead, all driver-related analysis used only Government-reported information; namely, the drivers were identified from inspections and/or crash reports. Thus, an overly high reporting of the number of drivers by a new entrant motor carrier made no difference in any analysis.

CHANGES IN SELECTION CRITERIA FOR THE 2010–12 CONTROL GROUP

The same basic approach that was taken for selection of the first-generation control was also taken for selection of the second-generation control group. However, some modifications were made to the selection criteria based on the availability of additional data and on the changing nature of new entrant carriers.

Timeframe

Again, the control group was selected from new entrant carriers during the same timeframe for entry as the timeframe in which training was offered. A review of the training program showed a few carriers with new entrant entry dates in June of 2010, and a few with new entrant entry dates in 2013. However, these appeared to be outliers. In order to best match the bulk of the carriers, July 1, 2010, was chosen as the start date for inclusion in the Control Group, and December 31, 2012, was chosen as the end date for inclusion in the control group.

The initial determination of start date was made based on the MCMIS "add date." The data that was included in the extract did not include the new entrant entry date. A review of the original control group carriers, using new data, showed that about 10 percent of these carriers had new entrant entry dates more than 60 days later than their add dates, but had new entrant entry dates within the selection timeframe. This suggests that there were some delays in the program, or that for some period of time these were intent carriers (i.e., they intended to begin interstate operations, but had not done so yet). About two-thirds of these carriers had new entrant entry dates after the cutoff. This suggests that these carriers had moved back and forth in status between intrastate and interstate.

The new criteria used the new entrant entry date, rather than MCMIS add date. A review of the data showed that 32 percent of the identified trained carriers had new entrant entry dates at least 60 days later than their MCMIS add dates. This is primarily because these carriers started as intrastate carriers and switched over to interstate operations. All carriers in Montana needed USDOT numbers because Montana is a PRISM State, and PRISM States track intra- as well as interstate carriers. Similarly, 27 percent of the control group carriers had a new entrant entry date that was more than 60 days after their MCMIS add date. As more and more States implement PRISM, more and more intrastate carriers have USDOT Numbers and are subsequently tracked on MCMIS.

Geographic Considerations

There was no change in the geographic considerations. The same States were included in the control group. These States included States that are adjacent to Montana and States adjacent to those States that had population densities similar to the population density of Montana. These States are:

- Colorado.
- Idaho.
- Nebraska.
- Nevada.
- North Dakota.
- Oregon.
- South Dakota.
- Utah.
- Wyoming.

Carrier Type

Again, only interstate carriers were considered in the control group.

Carrier Status

The original snapshot of MCMIS data only included carriers with a status of “Active.” This was not a choice. The data extract did not include information about carriers with a status of “Inactive.” The newer MCMIS snapshot data extract includes information about inactive carriers as well active carriers. Further, there are carriers with a status of “Inactive” among both the trained carriers and the carriers that declined training. Therefore, for the few analyses that did not depend on the number of power units (there is no power unit data for inactive carriers), carriers with a status of “Inactive” that met all of the other criteria were included in the new control group.

Carrier Size and Valid Ratios

The data needed to measure carrier size and determine valid ratios is only available (and relevant) for active carriers. For example, any measure that uses power units (e.g., crashes per power unit) should exclude carriers with invalid ratios. The decision to include or exclude carriers based on size and ratios was made for each test, rather than for the group as a whole. It is noted in the text where inactive carriers were excluded from the control group carriers.

APPENDIX E: DETAILED EXPLANATION OF STATISTICAL ADJUSTMENT METHODS

This appendix first discusses how the systematic differences in roadside inspection results among States was adjusted for the 2005–06 first-generation training to make them more statistically comparable. This was to assure that differences in safety performance measures were based on real differences in safety performance, and not on the patterns of inspection results in Montana as compared to the national averages.

Second, this appendix describes an enhanced version of the adjustment process that was used for the subsequent analysis of results from the 2010–12 program. The revised adjustment process takes into account the differences in patterns of inspection results in each State, not just the difference between patterns in Montana and nationwide patterns.

SYSTEMATIC DIFFERENCES IN ROADSIDE INSPECTION RESULTS AMONG STATES

There were two variations found among States: seasonal and systemic. Seasonal variations are regularly cyclic in nature. In some cases, effects are reversed when comparing northern and southern States. They likely are not an issue that needs to be focused on statistically.

Enforcement of the FMCSRs is predominantly State-based under the MCSAP grant program. FMCSA provides MCSAP grants to States based on each State's annual Commercial Vehicle Safety Plan. Section 350.201 of Title 49 provides 26 policy conditions that must be met by each State's plan. Within those policy guidance conditions, States are free to pursue whatever relative enforcement emphasis they desire.

Comparing States for inspections of all motor carriers, the differences in both number of violations and number of OOS orders from those violations indicate significant differences in enforcement focus from State to State.

The differences in State-to-State safety performance results from roadside inspections and MCSAP traffic enforcement are receiving more attention with the implementation of CSA. Industry trade articles are noting observable differences in SMS BASIC scores received by motor carriers, depending on the State in which the motor carrier is based. These differences flow from the fact that, generally speaking, assuming the motor carrier has more operations in their home State, they will have a higher chance of receiving more inspections in their home State.

Nationwide, the patterns of enforcement vary widely among States, just as with Montana and the control States. There appears to be no significant regional component to the differences. Figure 13 shows the driver OOS rates for each State averaged from July 1, 2010, through August 25, 2013. The lowest displayed is California, where 1.6 percent of all driver inspections resulted in driver OOS orders. The highest is Oregon, where 13.6 percent of all driver inspections result in driver OOS orders.

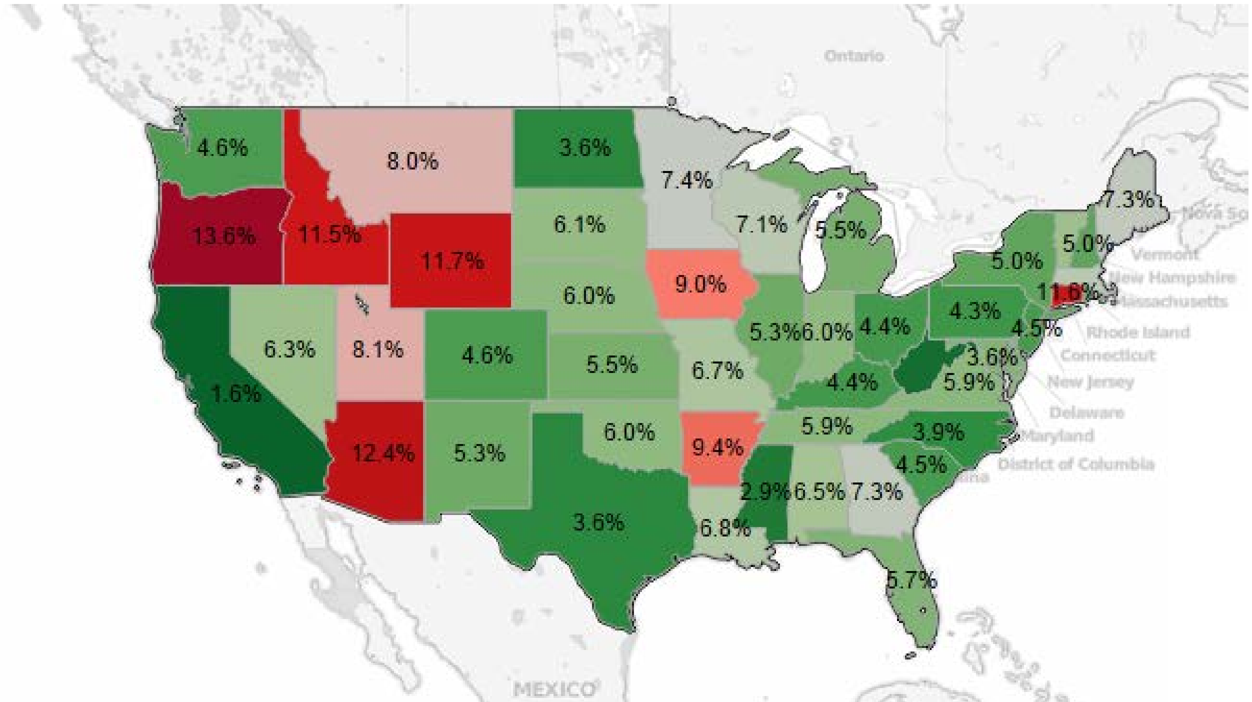

Figure 13. Image. Driver OOS rates from July 2010–August 2013.

For purposes of this analysis, such State differences in program enforcement emphasis cannot be allowed to have any impact on the possible differences in safety performance of new entrant motor carriers attributable to whether they received training. Therefore, it was necessary to make appropriate statistical adjustments to remove any bias for enforcement program differences, leaving the impact attributable to the training intervention.

Following are a few more detailed examples of differences in patterns of State enforcement programs based on data for 2007. Because these are from an earlier time period, they are slightly different than the averages for July 2010–August 2013.

- Frequency of driver violations and driver OOS orders:
  - In Oregon, 43.7 percent of inspections resulted in driver violations, and 15.7 percent of those inspections resulted in driver OOS orders. Thus, 36 percent of the inspections that resulted in driver violations also resulted in driver OOS orders.
  - In neighboring California, 8.4 percent of inspections resulted in driver violations, and 1.7 percent of those inspections resulted in driver OOS orders. There are two clear differences here. California has a lower rate of inspections that result in driver violations than Oregon, and only 20 percent of California inspections that resulted in driver violations also resulted in a driver OOS order.
  - In South Carolina, 53.4 percent of inspections resulted in driver violations, while 3.5 percent of inspections resulted in driver OOS orders. Again, there are two clear differences. South Carolina has a higher rate of inspections that result in driver violations than in Oregon or California, but only 6 percent of inspections that resulted in driver violations also resulted in a driver OOS order.

- Frequency of violations in Montana and in the rest of the Nation (based on data for the period from January 1, 2006, through August 2009):
  - Nationally, 69.32 percent of all inspections resulted in vehicle violations, and 52.26 percent of Montana inspections resulted in vehicle violations.
  - Nationally, 16.16 percent of all inspections resulted in vehicle OOS orders, while in Montana, 9.52 percent of inspections resulted in vehicle OOS orders.
  - Nationally, 34.94 percent of inspections resulted in driver violations, while 32.52 percent of Montana inspections resulted in driver violations.
  - Nationally, 6.31 percent of inspections resulted in driver OOS orders, while in Montana 8.89 percent of inspections resulted in driver OOS orders. This is the one measure where Montana issues more OOS orders than the national average.

Looking at vehicle inspection results, Table 42 shows the percentage of inspections resulting in vehicle OOS orders in States included in this analysis (Montana and control group States). These data are also from 2007 inspections. There are similar variations in other safety performance measures.

Another valuable finding illustrated in Table 42 is that the weighted average of differences in State enforcement emphasis for the control States is within one percentage point of the national average. For the first-generation adjustment method, researchers took advantage of this similarity to further simplify calculation of the adjustment factors used for the first-generation safety performance analysis.

Table 42. Variations in vehicle OOS rates (January 1, 2006, through August 2009).

State	Percent of Inspections Resulting in Vehicle OOS Orders
Colorado	18%
Idaho	23%
Nebraska	10%
Nevada	11%
North Dakota	7%
Oregon	20%
South Dakota	9%
Utah	16%
Wyoming	10%
Montana	10%
Control Group States	**15%**
National Average	**16%**

Differences in Program Emphasis in Montana

Looking at the differences for each of the safety performance measures, it seems evident that some portion of the differences in safety performance among the States is due to the fact that different States emphasize different aspects of enforcing the FMCSRs. It is also reported that States vary in how they interpret the FMCSRs, which can contribute to emphasizing the differences. Thus, it is critical that program emphasis differences are separated from new entrant training impacts.

If no adjustment is made for differences in Montana enforcement patterns as compared to national enforcement patterns, Montana trained new entrants would appear to have better safety performance metrics than the control group on most measures, but would be worse in driver OOS orders.

For example, Montana apparently does not emphasize vehicle enforcement in inspections as much as the other States do. Consequently, the percent of inspections resulting in vehicle OOS orders appears to be dramatically lower for Montana trained new entrants, who go on to have more of their inspections in Montana, as compared to control group new entrants.

Background for Calculating First-generation Adjustments

In order to compare safety performance among carriers fairly, it is necessary to calculate how much of the difference in the safety performance measures of Montana trained new entrants should be attributed to differences in States' enforcement program emphases. Remaining differences can then be attributed to the effects of training administered to Montana new entrants. The analysis makes an adjustment to expected values of safety performance measures based on differences in the percentage of inspections received in different States.

Montana-based trained new entrants received about 42 percent of their inspections in Montana, while control group new entrants had only 2 percent of their inspections in Montana. These differences were combined as one net value to keep calculations simpler for applying the possible impact of control State new entrant inspections in Montana to the net value for Montana. Thus, Montana-based new entrants in this study had a potential advantage of Montana inspection focus patterns for a net of 40 percent of inspections.

The "Adjustment Calculations" section below explains how adjustments were calculated to create adjusted expected values for each inspection measure. The raw values from control group new entrant measures were modified using these calculated adjustments to address different State enforcement program emphases.

Considerations were given to making finer State-specific adjustments, based on differences between enforcement patterns in control group States compared to national averages. However, for purposes of the first-generation analysis, the complexity of such adjustments was considered excessive. Any such adjustments would have to consider the number of control group new entrants in each State, the percentage of inspections control group new entrants had in their home State, and, potentially, patterns of control group inspections in nearby States. Development and calibration of such adjustments could be made part of a production system in the future. (The adjustment method developed for the second-generation analysis described below addresses those State-specific differences.)

The project team examined the number of inspections the control group as a whole had in each State outside of the control group States, compared to the overall number of inspections in each State. While the control group clearly had a larger than average percent of inspections in the upper Midwest and Mountain States, and a smaller than average percent of inspections on the

East Coast, inspections appeared reasonably randomly distributed, and the distribution was similar to the percent of inspections received by Montana trained new entrants.

ADJUSTMENT CALCULATIONS—FIRST-GENERATION ANALYSIS

The adjustments were calculated as follows:

- In order to get the representative national reference value, the value of each inspection measure was calculated using all data for all carriers that received inspections from January 1, 2006, through August 2009. Examples include vehicle violation rate and vehicle OOS rate. The calculated national values for each measure were chosen as the reference value, because they effectively average out differences in enforcement program emphasis among all States.
- The value for each of these parameters for all inspections in Montana for the same time period was then determined.
- The differences between values for all inspections nationwide and values for all inspections in Montana gave a measure of relative differences of Montana measures from the national average for each safety performance measure used in the study.
- A net of 40 percent of inspections on Montana trained carriers received the advantage (or disadvantage) of differences between Montana's enforcement patterns and national average enforcement patterns. Adjustment factors were calculated as 40 percent of the difference between the expected value for all inspections of that type nationwide and the average value for inspections of that type in Montana.
- Therefore, to make the control group's carriers' safety performance scores more statistically comparable to the expected value for each of the Montana groups' inspection-related measures, the adjusted control group safety performance scores were calculated as the value for the control group of new entrant carriers minus (or plus) the adjustment factor.

An example of how a final expected value is calculated (after adjustment) follows:

- The difference in Montana inspections that resulted in violations, as compared to all inspections (nationwide) resulting in violations, is 17.06 percent. This is calculated by subtracting the Montana rate of 52.26 percent from the national average of 69.32 percent.
- The difference of 17.06 percent is multiplied by 40 percent to calculate the percentage of Montana inspections subject to this difference in State enforcement programs. This gives 6.83 percent. This is the expected difference in their performance that is attributable to the difference in Montana enforcement program emphasis from the national average. So, 6.83 percent is subtracted from the control group's expected percent of inspections that resulted in violations.
- The inspection records for the control group show that 76.64 percent of their inspections resulted in violations. If all States in the control group had the same enforcement program emphasis, this would be the expected value under the null hypothesis.

- However, above we calculated an estimate of the difference in State enforcement program emphasis of 6.83. Therefore, we adjusted the expected value for inspections that will result in violations. Thus, the null hypothesis expected value of inspections taken from the control States that would result in violations for Montana trained new entrants is 76.64 percent minus 6.83 percent, or 69.82 percent.

This process is repeated for each of the inspection-related indirect measures available from the MCMIS data. Table 43 illustrates each component and adjustment factor calculated for each measure. This table (and the associated adjustments used for the analysis) uses all inspections from January 1, 2006, to the data extraction cutoff in August 2009.

Table 43. Calculation of adjustment factors.

Measure	National All Inspections	Montana Inspections	Difference	Net Percent of Montana Inspections	Adjustment Factor
Percent of Inspections With Violations	69.32%	52.26%	17.06	40%	6.83%
Percent of Inspections With OOS Orders	21.02%	17.32%	3.7	40%	1.48%
Percent of Inspections With Driver Violations	34.94%	32.52%	2.42	40%	0.97%
Percent of Inspections With Driver OOS Orders	6.31%	8.89%	-2.58	40%	-1.03%
Percent of Inspections With Vehicle Violations	50.84%	29.00%	21.84	40%	8.74%
Percent of Inspections With Vehicle OOS Orders	16.16%	9.52%	6.64	40%	2.66%

These adjustments removed differences caused by varying State enforcement emphasis patterns. The remaining differences between the adjusted null hypothesis expected values for these measures and the actual Montana values reflect an estimate of differences in safety performance attributable to the training.

An interesting impact of these adjustments to the expected values is that they systematically narrowed the difference between the expected values and the Montana observed values. This made it less likely for the analysis to demonstrate statistically significant differences in those measures.

Numerical Example

Adjustments described in the previous “Adjustment Calculations” section change expected values in the following way. In the analysis time period, new entrants based in control States had 34,997 of 47,775 inspections (73.25 percent) result in vehicle violations. During this timeframe, Montana homework new entrants had 1,140 inspections in control States.

If we were to apply the unadjusted expected percentage for new entrants based in control States (i.e., the 73.25 percent without adjustment for enforcement program emphasis differences), we would predict that 73.25 percent (or 835 of the 1,140 inspections on Montana homework new entrants) would result in violations—i.e., the raw expected value.

However, in applying the adjusted value for this measure, we would predict that for a randomly drawn sample of new entrants based in Montana, the expected percent of those inspections that would have resulted in violations would be 73.25 percent minus the 6.83 percent adjustment factor, or 66.42 percent of the inspections. Numerically, we would then expect that 757 inspections (not the 835 inspections predicted without the adjustment for enforcement program emphasis difference) would result in violations.

The MCMIS data show that only 680 of the 1,140 inspections of Montana homework new entrants, or 59.65 percent of inspections, resulted in violations. This gives a Z score of 4.85. (The Z score is the difference between the actual value measured from the study group and the expected value measured from the population or control group divided by the standard deviation.) Thus, we can reject the null hypothesis that, for this measure, the Montana homework new entrants could have been randomly selected from the control group. Statistically, the performance of the Montana homework new entrants, even with the adjustment for the difference in inspection patterns, is still very significantly different from the performance of the control group new entrants.

ADJUSTMENT CALCULATIONS—SECOND-GENERATION ANALYSIS—OVER OR UNDER EXPECTED VALUE

The wide differences in enforcement patterns among States continued from the first-generation analysis to the second-generation analysis. In Figure 13, we showed these differences by State. Table 44 shows the percent of driver and vehicle inspections resulting in violations and OOS orders by State, for the second-generation analysis timeframe.

Table 44. Inspection statistics by State, July 1, 2010, through August 25, 2013.

	Number of Inspections			Percent of Inspections Resulting in OOS Orders		Percent of Inspections Resulting in Violations	
State	**Total**	**Driver**	**Vehicle**	**Driver**	**Vehicle**	**Driver**	**Vehicle**
AK	21,377	20,529	12,260	3.8%	20.5%	23.4%	63.9%
AL	130,812	130,066	84,541	6.5%	18.1%	31.8%	59.3%
AR	127,845	127,512	68,988	9.4%	25.6%	40.2%	66.2%
AS	1,517	1,491	1,161	1.9%	20.0%	10.9%	58.3%
AZ	229,668	228,109	127,329	12.4%	19.3%	50.6%	79.2%
CA	1,770,575	1,546,855	1,299,827	1.6%	15.1%	7.1%	48.5%
CO	105,281	101,813	47,892	4.6%	25.9%	29.2%	65.9%
CT	64,364	62,422	42,629	11.6%	36.8%	50.9%	85.9%
DC	18,407	18,342	8,579	3.6%	21.0%	41.6%	61.2%

	Number of Inspections			Percent of Inspections Resulting in OOS Orders		Percent of Inspections Resulting in Violations	
State	Total	Driver	Vehicle	Driver	Vehicle	Driver	Vehicle
DE	18,182	17,899	14,048	5.7%	18.0%	42.2%	42.3%
FL	345,979	344,117	204,488	5.7%	20.5%	22.6%	65.1%
GA	281,096	278,727	151,157	7.3%	19.3%	41.8%	69.6%
GU	9,306	7,583	7,694	3.1%	14.4%	10.5%	28.9%
HI	12,805	10,102	10,342	1.3%	9.0%	8.8%	40.2%
IA	174,866	174,422	100,220	9.0%	24.1%	53.6%	76.2%
ID	32,712	29,716	21,286	11.5%	30.8%	57.3%	80.2%
IL	189,483	187,968	109,432	5.3%	24.4%	36.4%	59.4%
IN	287,289	286,578	97,158	6.0%	20.7%	55.9%	66.4%
KS	168,854	168,392	107,374	5.5%	14.5%	30.9%	55.3%
KY	323,604	321,374	202,836	4.4%	21.5%	25.7%	46.9%
LA	173,271	172,884	118,081	6.8%	30.5%	37.1%	78.7%
MA	59,921	55,734	35,462	7.1%	25.7%	65.3%	69.3%
MD	351,895	338,318	284,937	5.7%	17.8%	26.1%	51.0%
ME	48,961	48,461	35,161	7.3%	16.9%	22.5%	55.0%
MI	180,087	179,556	111,788	5.5%	18.8%	52.4%	71.3%
MN	118,492	115,561	80,450	7.4%	25.8%	42.3%	70.8%
MO	295,530	290,159	209,739	6.7%	31.2%	38.8%	68.0%
MP	3,566	3,369	2,748	11.7%	31.1%	35.3%	82.2%
MS	231,486	228,199	133,307	2.9%	13.2%	12.3%	39.8%
MT	116,901	116,012	51,155	8.0%	23.6%	26.6%	62.0%
NC	276,534	274,932	189,559	3.9%	15.8%	26.5%	48.0%
ND	46,177	45,436	16,408	3.6%	14.2%	26.5%	46.6%
NE	94,796	93,857	31,064	6.0%	33.6%	37.8%	69.8%
NH	35,877	35,062	24,919	5.0%	24.0%	32.2%	67.9%
NJ	123,006	121,792	82,215	4.5%	19.9%	24.9%	68.5%
NM	283,694	280,485	132,955	5.3%	16.7%	33.9%	50.2%
NV	106,442	105,237	79,084	6.3%	10.4%	29.0%	55.4%
NY	341,136	336,679	258,213	5.0%	22.5%	21.5%	62.0%
OH	248,700	234,126	213,426	4.4%	22.4%	28.8%	65.7%
OK	81,091	80,099	50,477	6.0%	21.9%	51.1%	59.2%
OR	159,533	155,927	105,384	13.6%	27.9%	28.7%	59.6%
PA	356,111	351,581	250,851	4.3%	19.5%	26.2%	56.7%
PR	11,920	9,227	7,122	5.7%	24.4%	59.6%	67.2%
RI	10,237	9,992	6,904	5.2%	27.7%	48.6%	81.4%
SC	158,271	154,685	85,314	4.5%	26.2%	55.0%	66.7%
SD	89,418	89,306	39,896	6.1%	17.2%	33.2%	56.7%

	Number of Inspections			Percent of Inspections Resulting in OOS Orders		Percent of Inspections Resulting in Violations	
State	**Total**	**Driver**	**Vehicle**	**Driver**	**Vehicle**	**Driver**	**Vehicle**
TN	229,740	228,960	125,514	5.9%	20.9%	24.4%	50.3%
TX	1,370,445	1,365,075	1,255,050	3.6%	21.2%	23.4%	78.0%
US	432,570	421,803	374,859	2.0%	16.5%	55.4%	75.4%
UT	110,141	108,271	44,185	8.1%	30.3%	33.3%	69.6%
VA	115,310	111,392	90,061	5.9%	25.1%	29.5%	68.3%
VT	20,779	20,223	14,181	6.3%	18.6%	43.9%	70.6%
WA	332,513	321,521	165,319	4.6%	23.9%	36.6%	67.2%
WI	100,271	99,679	80,459	7.1%	27.5%	39.1%	83.3%
WV	95,128	91,468	63,460	2.2%	13.8%	30.0%	49.8%
WY	59,474	59,304	24,520	11.7%	28.0%	44.3%	67.0%
Overall	11,183,446	10,818,389	7,593,468	5.0%	20.2%	29.7%	62.8%

The method used in the first-generation analysis proved sufficient, and provides a starting point for the expanded approach used for this analysis. The first-generation method directly accounted for the differences between inspections in Montana and the national averages as a close approximation of the weighted average for the control group. The method used for the second-generation analysis instead took into account each State's pattern of inspection results and compared the carrier's results in each State to the averages in each State.

After comparing the carrier's performance in each State to the State's averages, a weighted average (based on the percent of the carrier's inspections in each State) is accumulated. The net result is a percentage above or below what would have been expected, if the carrier's performance had been exactly average.

Example

Table 45 below uses data for four States from Table 44 above. The adjustment process looks at the percent of driver inspections that resulted in driver OOS orders. It weights the amount the carrier is above or below the State's percentage by the percentage of all driver inspections, nationally, that occurred in the State. This is because there is significant variability in the driver OOS rates from State to State.

- Almost 14 percent of all (national) driver inspections occurred in California. California had one of the lowest percentages of driver inspections resulting in driver OOS orders. Only Hawaii has a smaller percentage of driver inspections resulting in driver OOS orders.
- Slightly more than 13 percent of the driver inspections nationally occurred in Texas. The percent of inspections resulting in driver OOS orders in Texas is about 75 percent of the national average.

- In comparison, inspections in Oregon and Arizona result in driver OOS orders at more than twice the national average.

Table 45. Percent of inspections resulting in driver OOS orders and percent of all driver inspections nationally.

State	Driver OOS Rate	Percent of All Driver Inspections
CA	1.56%	13.97%
TX	3.63%	13.23%
AZ	12.52%	2.15%
OR	13.32%	1.50%

Example 1 uses the following experiences:

- Carrier A has 10 driver inspections in Texas, resulting in 1 driver OOS order, and 15 driver inspections in California, that resulted in 1 driver OOS order.
- Carrier B has 10 driver inspections in Arizona, resulting in 1 driver OOS order, and 15 driver inspections in Oregon, resulting in 1 driver OOS order.

Both of these carriers have 25 driver inspections and 2 driver OOS orders. Thus, both of these carriers had 8 percent of their 25 driver inspections result in OOS orders. What this procedure does is look at the percent over or under for the States where the driver OOS orders were received, which gives a perspective of how different each carrier's performance is from what would have been expected in each State. Applying this adjustment process reveals that the safety performance of these two carriers are far from equal.

Carrier A

The calculations for Carrier A are shown in Table 46.

Table 46. The driver OOS performance of Carrier A was 0.056 above (worse than) expected.

State	Driver Inspections	Inspections with Driver OOS	Driver OOS Rate	State OOS Rate	Above (or Below) Expected Value	Portion of Contribution	Contribution
TX	10	1	0.100	0.037	0.063	0.40	0.025
CA	15	1	0.067	0.016	0.051	0.60	0.031
Total Inspections	25	Overall Above (or Below) Expected Value					0.056

Carrier A had 10 of their 25 driver inspections (or 40 percent) in Texas, with 1 driver OOS order. This is a rate of 0.10 of their Texas driver inspections (or 10 percent) resulting in driver OOS orders. On average, in Texas, the rate of driver inspections resulting in driver OOS orders is 0.037 (or 3.7 percent). The difference is 0.063 (0.10 – 0.037). This difference is multiplied by the portion of the carrier's inspections that occurred in Texas (.40), and the contribution to the expected result for the carrier, giving 0.025 (0.063 multiplied by 0.40) worse than expected.

Similarly, Carrier A had 15 of 25 driver inspections (or 60 percent) occur in California that resulted in 1 driver OOS order, for a rate of 0.067. On average, in California the rate of driver inspections resulting in a driver OOS is 0.016 (or 1.6 percent). The difference is 0.051 (0.067 – 0.016). This difference is multiplied by the portion of the carrier's inspections that occurred in California (.60), and the contribution to the expected result for the carrier, giving 0.031 worse than expected. Overall, Carrier A had a driver OOS rate 0.056 worse expected.

Carrier B

The calculations for Carrier B are shown in Table 47.

Table 47. The driver OOS performance of Carrier B was 0.056 below (better than) expected.

State	Driver Inspections	Inspections with Driver OOS	Driver OOS Rate	State OOS Rate	Above (or Below) Expected Value	Portion of Contribution	Contribution
AZ	10	1	0.100	0.125	-0.025	0.4	-0.01
OR	15	1	0.067	0.133	-0.066	0.6	-0.04
Total Inspections	25	Overall Above (or Below) Expected Value					-0.05

Carrier B had 10 of their 25 driver inspections (or 40 percent) in Arizona, with 1 driver OOS order. This is a rate of 0.10 of their driver inspections (or 10 percent) resulting in driver OOS orders. On average, in Arizona, the rate of driver inspections resulting in driver OOS orders is 0.125 (12.5 percent). The difference is -0.025 (0.10 – 0.125). This difference is multiplied by the portion of the carrier's inspections that occurred in Texas (.40), and the contribution to the expected result for the carrier is -0.01 (-0.025 multiplied by 0.40) below expected. Amounts below expected are shown with a negative sign.

Similarly, Carrier B had 15 of their 25 driver inspections (or 60 percent) occur in Oregon and resulted in 1 driver OOS orders, for a rate of 0.067. This is -0.066 (0.067 – 0.133) below Oregon's average of 0.133. Driver inspections in California contributed -0.04 (-0.66 multiplied by 0.6) below expected to Carrier B's total. Overall, Carrier B had a driver OOS rate 0.05 below expected.

Summary

Thus, even though the two carriers had 2 driver OOS orders in 25 driver inspections, Carrier A's performance was considerably worse (i.e., above what would have been expected for the States where inspected by 0.056). Carrier B's performance was much better (i.e., below what would have been expected by 0.05), considering the States in which they were inspected.

Methodology Details

The actual calculations are performed using the following steps to calculate the appropriate measure of over or under expected value for each carrier.

1. The entire baseline population of inspections (and therefore carriers with inspections) is identified. For this study, the population of inspections was all inspections from July 1, 2010, through the data cutoff of August 25, 2013. Other base populations for different time periods will be appropriate for other analyses.
2. For the entire population of inspections, calculate the overall statistics being analyzed. For this study, the statistics calculated were overall OOS rate (i.e., percent of inspections resulting in OOS orders), driver OOS rate (i.e., percent of driver inspections resulting in driver OOS orders), vehicle OOS rate, overall violation rate, driver violation rate, and vehicle violation rate. For example, in the national population for this time period, 04.97 percent of the inspections resulted in driver OOS orders.
3. For each State, calculate the overall statistics being analyzed. For example, for Texas, the overall driver OOS rate was 0.0363, or 3.63 percent.
4. For each carrier in each State, calculate the overall statistics being analyzed. Note: many carriers had both driver and vehicle inspections in a State, some carriers had driver and no vehicle inspections, and some carriers had vehicle but no driver violations. All three conditions need to be accounted for. For example, Carrier A's driver OOS rate in Texas was 0.10.
5. For each carrier in each State, based on the statistics for the carrier and the statistics for the State, determine the amount over (or under) the expected value for each statistic in the State. For example, for Carrier A, the driver OOS rate in Texas was 0.063 over expected.
6. For each carrier, determine the total number of inspections of each type. For example, for Carrier A, there were 25 driver inspections overall.
7. For each carrier in each State, and for each type of inspection, determine the percentage of the carrier's inspections that occurred in each State. For example, for Carrier A, 40 percent of their driver inspections occurred in Texas.
8. For each statistic, for each carrier, sum the contributions from each State where the carrier had inspections to determine the carrier's total amount above or below expectation. So, for example, for Carrier A, their overall driver OOS rate was 0.056 above what was expected for the States where inspected.

This provides the baseline statistics for each carrier. For groups of carriers (such as the trained carriers, or the control group carriers), these statistics can be calculated for the group as well. In order to calculate the statistics for the group, the following steps are performed:

1. Identify the baseline statistics being used for the calculation.
2. Identify the subgroup.
3. Calculate the total number of inspections of each type.

4. For each carrier, for each type of inspection, calculate the carrier's portion of the inspections as a percentage of all of the inspections for the subgroup.
5. For each statistic, calculate the carrier's contribution to the group as the carrier's value in the statistic times the carrier's portion of the group.
6. For each statistic, sum the carrier's contributions to the group.

Results

Running this refined analysis process for the second-generation trained carriers produced somewhat different results from the first-generation analysis. The results of applying this more detailed analysis to the first-generation training are presented for the three target groups in Table 51.

Based on the results from the first-generation analysis, the following results for the second-generation control group seemed reasonable. The comparatively poorer showing of the second-generation trained carriers than that of the first-generation carriers is largely explained by the five outlier carriers (about 2.5 percent of the trained group) that had very poor performance. Based on the much lower number of inspections received on trained new entrants from the second-generation, it is suspected that the five outlier carriers may have operated in the Bakken oil-shale fields, where there is considerably higher operating risk. So it is not surprising in the economic environment in eastern Montana that existed during the second-generation training and testing that such higher outlier safety performance could occur.

Table 48. Inspection statistics over (or under) expected.

Measure	Comparative Driver OOS Rate	Comparative Vehicle OOS Rate	Comparative Driver Violation Rate	Comparative Vehicle Violation Rate
Montana Homework New Trained Carriers (204)	*1.82%*	**15.44%**	10.66%	11.12%
Montana Carriers Declining Training (578)	3.27%	5.50%	8.86%	7.54%
Control Group (11,561)	3.76%	6.59%	8.13%	9.85%

As expected, the control group did not perform up to average in any measure, and was well above expected on all measures. Table 49 shows the underlying data for the Control Group. This will also help the reader understand the meaning of these numbers.

- Based on the States of inspection, the control group would have been expected to have 6.6 percent of their driver inspections result in driver OOS orders. This is somewhat above the national average, undoubtedly because the new entrants from the control group States had so few inspections in California and Texas. In fact, the control group had 10.4 percent of their driver inspections result in driver OOS orders. This is actually 57 percent above what would have been expected.
- The control group would have been expected to have 22.6 percent of their inspections result in vehicle OOS orders. They had 29.2 percent of their inspections result in vehicle OOS orders, 29 percent above what would have been expected.

- The control group would have been expected to have 31.8 percent of their inspections result in driver violations. They had 40.0 percent of their inspections result in vehicle OOS orders, 26 percent above what would have been expected.
- The control group would have been expected to have 62.6 percent of their inspections result in driver violations. They had 75.5 percent of their inspections result in vehicle OOS orders, 16 percent above what would have been expected.

These are summarized in Table 49.

Table 49. Control group—actual data.

Category	Driver OOS Rate	Vehicle OOS Rate	Driver Violations Rate	Vehicle Violations Rate
Control Group Actual	10.35%	29.17%	39.97%	72.47%
Expected	6.59%	22.59%	31.83%	62.62%
Difference	3.76%	6.59%	8.13%	9.85%
Percent Above Expected	57.03%	29.17%	25.55%	15.73%

It is a function of the nature of the statistic that the smallest measured difference—the difference in driver OOS rate—was, as a percent of the actual expectation, the largest percentage difference. Similarly, the statistic with the largest measured difference—percent of inspections resulting in vehicle violations—was the smallest deviance from expectation.

For easy reference, Table 50 repeats the value for these at the national level from Table 44 above.

Table 50. Nationwide averages of inspection measures—July 1, 2010, through data cutoff.

Measure	Driver OOS Rate	Vehicle OOS Rate	Driver Violation Rate	Vehicle Violation Rate
Nationwide Averages	5.0%	20.2%	29.7%	62.8%

Validation

Because the findings using this more detailed methodology for the second-generation training were sufficiently different from the findings from the first-generation 2005 06 study, the researchers decided to run the more detailed analysis developed for the second-generation analysis on the first-generation data from the 2005–06 training. This was done as much to validate the new methodology as it was to reconfirm the original findings. The results from application of the detailed methodology on the first-generation data are shown in Table 51.

Table 51. Measures for 2005–06 target groups above or below expected values—original data.

Measure	Comparative Driver OOS Rate	Comparative Vehicle OOS Rate	Comparative Driver Violation Rate	Comparative Vehicle Violation Rate
Original Fully-trained Carriers	-0.48%	1.01%	-3.56%	0.48%
Original No-homework Carriers	-0.31%	9.74%	3.94%	12.22%

Measure	Comparative Driver OOS Rate	Comparative Vehicle OOS Rate	Comparative Driver Violation Rate	Comparative Vehicle Violation Rate
Original Control Group	2.77%	5.44%	7.46%	6.42%

The performance of the original group of fully-trained carriers was again determined substantially and significantly better than the performance of the original control group in every inspection measure. As with the previous methodology, the performance of the original group of fully-trained carriers as compared to all carriers was better in some areas, but statistically indistinguishable from the performance of all carriers.

As another review of the value of the new more detailed methodology on evaluating the effectiveness of the training, the performance of the carriers from each of the three target groups from the 2005–06 study who are still active in 2013 was reviewed in their inspections during the analysis period for the second-generation analysis. As Table 52 demonstrates, the control group was worse than the national average in all of the inspection measures. The homework trained carriers were again determined better than average in the critical driver-related measures. However, as with the previous methodology, the trained carriers were again found not up to the national averages in the vehicle-related measures.

Table 52. Measures for remaining carriers from 2005–06 target groups above or below expected values—inspections from July 1, 2010, through the data cutoff.

Measure	Comparative Driver OOS Rate	Comparative Vehicle OOS Rate	Comparative Driver Violation Rate	Comparative Vehicle Violation Rate
Original Fully-trained Carriers	-1.51%	3.70%	-1.86%	10.67%
Original No-homework Carriers	0.66%	-0.78%	8.88%	8.93%
Original Control Group	1.11%	3.78%	4.81%	5.66%

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APPENDIX F: ALTERNATIVE MEASURES OF CRASH RATE

CRASH RATE

MCMIS crash data include identification of both drivers and carriers. The commonly calculated metric of crash rate by power units per carrier is a carrier-centric measure. It does not provide information about drivers' total driving behavior and how the drivers' behavior relates to the carriers' hiring practices.

It is fairly straightforward to count the number of crashes for a motor carrier in MCMIS data. However, the raw number of crashes reported for a motor carrier by itself does not tell you anything useful about risk. This is clearly illustrated by a motor carrier such as the United Parcel Service (UPS), which has a high number of crashes, because they are among the biggest motor carriers in MCMIS. Yet, by any measure other than raw count, they are one of the safest motor carriers. What is needed is to convert the raw number into a meaningful metric as a measure of exposure: crashes per what?

FMCSA uses exposure rates in its SMS evaluation software. In SMS, carriers are grouped into peer groups by size (i.e., number of reported power units) when calculating percentiles for identifying high-risk carriers. A common exposure rate, used for many years, is the number of power units operated by that motor carrier, as self-reported by the motor carrier at least every 2 years on the MCS-150 form. FMCSA recently decided to modify (slightly) how it assesses exposure rate:

- SMS uses an average of reported power units across time (current power units, plus power units 6 months ago, plus power units 18 months ago) rather than just the most recently reported number of power units.
- If a carrier operates its power units for an above-average number of miles, SMS will adjust the implied power unit number upward by a factor to reflect the higher exposure because of the higher mileage (which is also self-reported).

Nonetheless, the number of reported power units remains the central element in FMCSA's exposure measure.

This report adds use of another crash rate metric, carriers' drivers' crash rate.

- **Carrier Crash Rate per Power Unit.** The numerator in this measure is the number of crashes reported by States attributed to that specific new entrant motor carrier by its USDOT number. The denominator is the number of power units self-reported by the new entrant. The actual analysis is described in Section 3.2.1. The main difference between this approach and the SMS approach is that SMS uses a weighted average of power units from the carrier, rather than using a single report, and may weigh the number of power units if the number of miles traveled is high enough. This creates a moving average of the reported power units, not the most current reported amount.

- **Crash Risk Rate per Carriers' Drivers**. An important goal of this alternative measure of crash rate is to broaden analysis of new entrant crash performance by taking advantage of the additional behavioral information available about the drivers involved in the crashes. Thus, the numerator in this measure is the total of all crashes attributed to all drivers that the analysis is able to associate with that target group of carriers for the analysis period. There are two possible sources of data for the association of drivers to a new entrant: inspections and crashes. As explained earlier, this analysis uses the drivers associated with new entrants only by inspections. The denominator is the number of drivers (or driver years) associated with the target new entrant group.

The exposure measures from these two statistical methods are, in turn, dependent on the two different methods of obtaining the data necessary to calculate the exposure:

- The measure of crash rate per power unit depends on self-reporting by new entrant motor carriers.
- In contrast, the carriers' drivers' crash rate depends on data from official State reporting via SAFETYNET to MCMIS. The use of State-reported safety performance events uses better trained reporters and prevents new entrants from "gaming" the system.

CARRIERS' DRIVERS' CRASH RATE

The concept for the metric was initially developed as a way to rate individual carriers using all crash data for all drivers associated with that carrier, in which case it was the carrier's (singular) drivers' crash rate. However, in this study, it is applied to compare target groups of new entrants. Thus, in this application it becomes the carriers' (plural) drivers' crash rate.

At its basic level, the carriers' drivers' crash rate is simple.

- The analysis associates all drivers detected to have driven with the target group, in this case a group of new entrants. In this context, the association is made using State-reported inspection contact data. In this study, drivers were associated with the denominator of the target group of new entrants based on MCSAP inspections reported via SAFETYNET:
  - Each inspection on a homework new entrant results in that driver being associated with that target group (i.e., the homework new entrant group).
  - Each inspection on a no-homework new entrant results in that driver being associated with the no-homework new entrant group.
  - Each inspection on a control group new entrant results in that driver being associated with the control group.
  - Similarly, for the second-generation analysis, each inspection on the Montana declined group results in that driver being associated with the declined group.
- All crashes for each driver are added together to give that driver's profile.
- All crashes associated with each driver's profile are added to the numerator of each carrier that driver is associated with, according to the inspection data.

- The carriers are added together by target group (e.g., homework, control group).
- The crash rate for each target group of new entrants' drivers is calculated (total crashes of all drivers, divided by the number of attributed drivers). For the first-generation analysis, the actual statistic is crashes that occurred during the analysis period, which is January 2006 through August 2009. For the second-generation analysis, it is the crashes that occurred between July 1, 2010, and August 25, 2013

The following sections offer several different explanations of the meaning of this metric, in conceptual as well as practical terms.

Conceptual Overview of Carriers' Drivers' Exposure Measure

The carriers' drivers' crash rate is a specific example of a class of measures that may be used to evaluate carriers' performance. In this measure:

- Drivers are associated with the target group of new entrants.
- The target groups of new entrants are evaluated based on the total performance of their drivers for the period of analysis. This includes their driving behavior while working for other carriers during the evaluation period.

This method is essentially looking at crashes from a driver-centric perspective, which creates a different benefit than looking at crashes from a carrier-centric perspective:

- It includes crashes of the driver while working for all carriers during the evaluation period.
- It measures the driver's entire performance, not just the driver's performance when working for the target group. Thus, it provides a measure of the safety culture of the target group. One reason it enables us to measure carriers' safety culture is that the new entrant carriers had access to various screening tools. They have had access to driver histories for many years, to see the traffic conviction safety performance measures of drivers. The hiring choices made by these new entrants, based on information about the drivers' safety performance, is a measure of safety culture of the carrier, and together of the group. For example, if the new entrant did not avail themselves of the driver screening tools, that is an indicator of their lack of sufficient interest in safety.
- This ability to measure a new entrant's embracement of a safety culture became even more pronounced in 2010 when FMCSA implemented the Pre-employment Screening Program (PSP). PSP now provides hiring carriers access to drivers' MCMIS crash and inspection data, which includes crashes, inspection violations, and driver OOS history. Thus they have access to an authoritative source of crash data for that driver.
- Note. Information about the inspection data became important to motor carriers because with adoption of SMS, all FMCSR driver violations are considered in ranking the carrier's safety performance, not just driver OOS.

Because this analysis method associates the driver's entire driving behavior with each hiring carrier group, this method is very valuable for evaluating carrier groups' safety culture.

The carriers' drivers' crash rate has other significant benefits:

- It has, at its core, a valid measure of exposure. It assumes that, during any selected period, say a year, a driver may be considered to have driven a "driver year." During that year, the driver accumulates a driver-year's worth of events and data.
- It is based on State-reported safety performance event data. There is no need to depend on carrier self-reported power units, or self-reported miles driven, or any other carrier self-reporting.
- This measure has proven effective in identifying groups of carriers that are spreading their driver and/or vehicle safety violations across multiple motor carriers. This may be valuable for identifying which low-cost, curbside passenger bus operations are spreading violations to avoid being targeted for poor safety performance. Some are known to have interconnected operating companies, thus spreading their violations.
- This measure is expected to be good at identifying those carriers that are members of a pool of cooperating carriers spreading their safety violations in order to avoid being targeted for closer evaluation or a possible compliance review. Such patterns of cooperative pooling of drivers and/or equipment are being observed, particularly in some motorcoach operations.

As pointed out earlier, this measure is equally applicable at the individual motor carrier level, which is what it was initially developed to do. It was originally used in the Driver/Carrier Study performed for the American Association of Motor Vehicle Administrators, to demonstrate a correlation between driver behavior and carrier management practices, or what this study is referring to as the "safety culture" of the motor carrier.

The original approach used violations based on the driver having received a traffic citation, not crashes. One unanticipated benefit of this analysis approach was that it effectively identified motor carriers that were spreading their violations across a pool of cooperating motor carriers, and therefore were not otherwise individually identified as high risk. The enforcement personnel guiding that research were familiar with the groups of carriers identified by this analysis technique as high risk and provided the information that those enterprises had subdivided their business into multiple cooperating carriers. Thus, they were spreading drivers and vehicle violations among several carriers.

State participants in the Driver/Carrier Study found that identification of spreading violations was particularly valuable, because it enabled them to identify which of those carriers to focus on. The State MCSAP personnel considered those carriers as particularly dangerous, but up to that point they were not identified by any existing carrier-centric statistical measure. Even FMCSA's SMS, which uses a carrier-centric methodology, does not readily identify such motor carriers engaging in cooperative pooling of drivers and/or equipment to spread their violations.

Original Approach to Carrier's Drivers' Violation Rate

This explanation provides the actual analysis path that led to development of the measure. The original plan was to identify individual carriers that might be of interest for further scrutiny.

The first element was to determine which carriers had many safety events (e.g., violations, crashes). If there were no safety events, or only a very few events, the carrier was not considered a problem. Note that this concept has the same limitation as SMS—namely, getting sufficient descriptive data about safety performance to identify small carriers of interest.

The next step was to see what could be determined for carriers that had a relatively large number of events. However, for those carriers (or in the case of the present analysis, groups of carriers) with many events, not much could be determined by looking only at the number of events. We had to determine whether large carriers had many events just because they had many drivers, or if they were, in fact, carriers of interest because of a high rate. As pointed out above, a classic example carrier is UPS, which has more crashes nationally than almost any other carrier. Nonetheless, UPS is considered to be one of the safest carriers. UPS has a very large number of drivers, each one contributing only a very small expected value for a safety event, such as a safety violation on an inspection, traffic ticket, or even a crash.

The opposite is a carrier with many events for relatively few drivers (e.g., a lot of inspection safety violations or crashes per driver). We can be relatively certain that such a carrier, with many events and few drivers, is more likely to be a problem carrier.

The problem, then, was how to distinguish safe carriers from problem carriers among carriers that have many drivers and many events:

- Some carriers employ drivers for long periods of time. In the classic example, some drivers may work for UPS for their entire driving careers.
- On the other hand, a number of carriers hire drivers for short periods of time, sometimes as short as a single trip. Or, they may contract with many owner-operators who operate under their own USDOT numbers (sort of a pooled group of carriers, but perhaps not detectable). Sometimes they lease owner-operators, associating both a new driver and a new power unit with the carrier. There is no reason to believe that any of the arrangements makes these carriers either safer or less safe than others. Nonetheless, these carriers end up with a large number of associated drivers (and, if measured, power units).

The issue then is to identify which of these motor carriers with many drivers and many events likely are problem carriers with poor safety cultures.

The carrier-centric approach of simply dividing the number of violations (or crashes) associated with that carrier by USDOT number (or target group of new entrants in this case) by the number of drivers employed by the carrier does not work:

- It results in a high (bad) score for carriers that have a smaller number of drivers, because they remain with them for lengthy periods.
- It results in a low (better) score for carriers that hire many drivers for short periods of time. It cannot identify problem carriers that hire many different drivers over short periods of time. Thus, carriers that have a bad safety culture remain hidden. This would include carriers with management practices that hire risky drivers, do not encourage safe driving, or actively discourage safe driving.

The alternative concept of the carrier’s drivers’ measure deals directly with this situation.

A driver-centric approach is used to associate violations or crashes with a carrier. Thus, the full measures of driving behavior of every driver associated with a carrier is “assigned” to each carrier that the driver is associated with through an inspection. Whether a particular safety event occurred when the driver was working for that carrier is irrelevant. The driver’s total safety behavior is a measure of that carrier’s overall safety behavior pattern. By the act of that carrier deciding after screening to hire that driver we get a measure of the underlying associated culture of that carrier.

The carrier is assigned all the drivers that can be associated with that carrier. For the Driver/Carrier Study, associations of drivers with carriers were made using State Police traffic citations. For the present study, associations are made using MCSAP roadside inspections. The carrier is assigned all the safety events associated with those associated drivers. The carriers’ drivers’ rate thus is the number of total driver-centric events divided by the number of associated drivers.

For the Driver/Carrier Study, the carrier’s drivers’ violation rate was the number of violations associated with the carrier’s drivers divided by the number of the drivers associated with that carrier target group.

Carriers’ Drivers’ Crash Rate

Similarly, for this study, the carriers’ drivers’ crash rate for a target group for any given period is the number of crashes associated with the target group’s (carriers’) drivers, divided by the number of the drivers associated with that carrier target group.

Thus, if the target group of carriers hires a very large number of drivers that work for the carriers for only one trip, and each of those drivers is very safe with almost no crashes, then the carriers’ drivers’ crash risk rate will be very low. If, on the other hand, each of those drivers has a high total number of crashes during the analysis period, then the carriers’ drivers’ crash risk rate will be very high.

The period of analysis for the first-generation analysis was from January 1, 2006, through August 26, 2009, or about 3.5 driver years for every driver associated with each new entrant. As a result, the new entrant target group with which the driver is associated “inherits” both the full behavior performance of the driver for the full 3.5 years and the full measure of exposure for that period. The period of analysis for the second-generation analysis was from July 1, 2010, to August 25, 2013, or about 3.17 years.

This crash rate is an indicator of the target group’s safety culture. If a carrier has a culture of safety, the carrier will not hire a driver with a bad safety record and will promptly remove drivers found to have bad safety habits. The drivers that a carrier hires and retains reflect the safety culture (and management practices) of the carrier. Similarly, even after the driver has moved on, if the carrier has nurtured the driver to embrace a good safety culture, it can be reflected in the driver’s future behavior. In this analysis, the group’s rate is the sum of the behavior of the members of the group.

Simple Example with Two Carriers

The following example is presented to give a concrete example of how the carrier's drivers' crash rate statistic works at the individual carrier level, and how it differentiates real safety performance.

Consider, for example, the following two companies:

- Quality Carrier has 1,000 drivers associated (through inspections) with the carrier and they work for the carrier the entire year. These drivers have a total of 30 crashes in the year, all of which are assigned to Quality Carrier. Viewing only Quality Carrier, it has a crash rate of 0.03 crashes per driver per year.
- Fly-by-Night Carrier also has 1,000 drivers associated (through inspections) with the carrier. These drivers had only 20 crashes, or a crash rate of 0.02 crashes per driver per year, while working for Fly-by-Night. However, the drivers employed by Fly-by-Night also worked for a number of other carriers during the same year and accumulated a total of 80 crashes in the year for all carriers. (These drivers had 60 crashes while working for other carriers.)

In the second case, looking just at the carrier-centric crash rate for crashes attributed to that carrier while drivers were working for them ignores the fact that Fly-by-Night is choosing to hire drivers with a much higher overall crash risk rate.

For Quality Carriers, the carrier's drivers' crash rate is 0.03 crashes per driver. For Fly-by-Night, the carrier's drivers' crash rate is 0.08 crashes per driver. Another way of thinking of this is that the drivers working for Fly-by-Night have a much higher probability of being involved in a crash (see Table 53).

Table 53. Comparative analysis of carrier's drivers' crash rates for example case.

Measure	Quality Carrier	Fly-by-Night Carrier
Total Number of Drivers	1,000	1,000
Total Number of Drivers in Crashes	30	80
Total Number of Crashes for Carrier's Drivers	30	80
Total Crashes While Working for the Target Carrier	30	20
Average Number of Crashes Per Driver—Carrier's Drivers' Crash Rate	0.03	0.08
Average Number of Crashes Per Driver While Driving for the Target Carrier	0.03	0.02
Percent of Crashes for the Target Carrier	100%	25%

Alternative Approach—Impact of Business Success

The following example illustrates another aspect of why the driver-centric carrier's drivers' crash rate is a powerful discriminator.

One of the goals of training new entrant carriers in business basics is to improve the success rate of carriers staying in business. If the second-generation homework new entrants trained in Montana were more successful than control group new entrants (and if first-generation homework new entrants were more successful than no-homework new entrants), then:

- The more successful new entrants are likely to retain a larger percentage of their original count of trucks in business several years after startup.
- The more successful new entrants that adopted a safety culture are also likely to retain a larger percentage of their drivers.

Carriers' Crash Rate

First let's look at crashes from the usual perspective. Namely, only crashes that occur while a driver is driving for a carrier are attributed to that carrier. Or in this case, carrier grouping. Since we are looking at this from a driver rather than a vehicle perspective, we still need to total up the number of drivers associated with that carrier, which we do by inspections.

Looking at these crashes from a carrier-centric approach—the carriers' crash rate—in 2009, there were 30 crashes in the file associated with the High Safety Culture Group (one-half crash per driver per year times 60 drivers). The only crashes associated with High Safety Culture Group are ones that occurred while the drivers were driving for this group. We associated the full 100 drivers with High Safety Culture via previous inspections, but the crashes that occurred while the drivers were driving for other carriers are not included in this carrier-centric measure.

In 2009, there were 30 crashes associated with the Low Safety Culture Group (three-quarters of a crash per driver per year times 40 drivers) while drivers were driving for them. Similarly, this methodology will have associated the previous full 100 drivers with Low Safety Culture, and crashes for drivers who left that occurred when they were driving for other carriers are not included.

Based on having associated the full 100 drivers with the carriers via previous inspections, the crash rates under this carrier-centric measure would appear to be identical at 0.3 crashes per carrier per associated driver.

A more data-driven way to look at this type of a carrier-centric crash rate is by using actual data from the first-generation analysis in Table 10 above for homework, no-homework, and control group carriers, which gives the following values:

- **Control Group—**There were 12,715 drivers with inspections for control group carriers where the driver information contained correctly-formatted DLNs. These 12,715 drivers had 618 crashes while those drivers were driving for and were associated with a control group carrier (i.e., the crash record showed the control group carrier's USDOT number). In other words, over the study period, the drivers associated with the control group carriers through inspection had 0.049 crashes per driver associated with that carrier group.

- **Homework Carriers—**There were 278 drivers associated with homework carriers through inspections. These drivers had a total of 11 crashes while those drivers were driving for them and were thus associated with the homework carrier group. In other words, over the study period, the drivers associated with that carrier group through inspection had 0.040 crashes per driver assigned to that carrier group by a USDOT number belonging to one of the carriers in the group by a USDOT number belonging to one of the carriers in the group. Again, this difference is not statistically significant.
- **No-homework Carriers—**There were 153 drivers associated with no-homework carriers through inspections. These drivers had a total of five crashes while those drivers were driving for them and thus associated with the no-homework carrier group. In other words, over the study period, the drivers associated with that carrier group through inspection had 0.033 crashes per driver assigned to that carrier group by a USDOT number belonging to one of the carriers in the group. The difference between 0.049 for the control group and 0.033 for the no-homework group is not statistically significant.

In summary, looking at this carrier-centric crash rate (i.e., number of carrier crashes divided by number of drivers associated with the carrier), not only are there no significant differences in the crash rates, but the crash rates for the three target groups are virtually indistinguishable because this method ignores the full measure of the drivers' crash behavior.

Carriers' Drivers' Crash Rate

In this alternative, all the drivers' crashes are taken into consideration by instead looking at the carriers' drivers' crash rate.

- For the High Safety Culture Carrier, there were a total of 100 drivers, who in 2006 would have had 50 crashes. Thus, the High Safety Culture Carrier's Drivers' crash rate would have been 0.50 crashes per driver.
- Similarly, the Low Safety Culture Carrier's Drivers' Crash rate would have been 0.75 crashes per driver.

In this example, the crash rate of drivers associated with High Safety Culture is 50 percent better than the crash rate of drivers associated with Low Safety Culture. This is very different from the simple carrier-centric 2009 calculated crash rate of 0.3 for the 2, based on the 100 drivers attributed to them by inspections.

Clearly, the Low Safety Culture Carrier's drivers are a much more dangerous group.

Both of these examples are well illustrated by the actual data presented in the body of this report.

- Dividing the count of carriers' crashes that occurred while the drivers were driving for that carrier by the count of carriers' drivers resulted in virtually the same crash rate for trained carriers and for the control group.
- When we instead divided the number of all crashes attributed to the carriers' drivers (no matter who they were driving for) by the number of carriers' drivers, it showed that

drivers associated with trained carriers, and especially homework carriers, had a substantially lower overall crash rate.

- The carriers' drivers' analysis also showed that the homework carriers successfully retained a higher percentage of their drivers over time. Thus, the percentage of their drivers' crashes that occurred while working for homework carriers was higher, because they were not as scattered among other carrier groups, but their drivers' total crash performance was substantially better than the performance of drivers associated with the control group.

Drivers associated with homework new entrants had comparatively few crashes while working for homework or any other subsequent carriers. Thus, the actual overall crash performance of homework carriers' drivers is much better than the overall crash performance of the control group's carriers' drivers. However, this difference was not measurable until the total crash performance of the target group carriers' drivers was taken into account (i.e., including all drivers' safety crash performance even when the drivers were working for other carriers).

Comparison of Self-reporting and State-reporting

Another important advantage of the carriers' drivers' crash rRate is that it uses official State-reported safety performance measures, not carrier self-reported data. There are a number of reasons why State-reported data should be considered more appropriate (and more accurate) than self-reported data on power units and miles driven.

- Most critically, there is no guarantee of the accuracy of self-reported data. The carrier can choose to over-report power units or miles driven, resulting in a lower calculated crash rate measure.
- Measures based on numbers of inspections match the timeframe of measured events with the timeframe of the exposure measure. Self-reported information is, by its nature, dated.
- Self-reported information is less sensitive to a change in the carrier's size. It depends on whether the carrier remembers occasionally to update the data. Growing carriers will receive worse scores than they deserve because they may be having crashes on a greater number of power units than they reported, while shrinking carriers will receive better scores than they deserve.
- Self-reported data are, by nature, estimates. Consider the data in Table 7 and Table 8. These are data from motor carriers' initial MCS-150 filings. Prior to filing the MCS-150, they were not approved to operate interstate. This raises a question: did they already finance the power units prior to becoming legal to operate in interstate commerce, or were they reporting on their business plans, not on actual vehicles? Perhaps this is why some new entrants report no power units. Perhaps more should be reporting zero. There is also the possibility that the carrier was operating intrastate, already had a number of power units, and was just registering to begin interstate operations.

Another reason State reporting is so useful is that it does not penalize the carrier for business success. FMCSA attempts to minimize the risk for penalizing a carrier for growing by recommending that the carrier regularly update its MCS-150 data, which include number of power units and annual mileage. If a growing carrier forgets to report a larger number of power units, the following happens: the carrier's crash rate is likely to be higher because of the greater exposure to crashes resulting from the larger number of power units. FMCSA does not have the current number of power units to use in calculating the carrier's crash rate, and thus calculates a higher crash rate. Further, SMS uses a moving average of number of power units, so even when a carrier reports an increase in power units, they do not all get included in the denominator used in calculating crash rate.

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APPENDIX G: MISCELLANEOUS

AVERAGE CRASH RATE BY CARRIER SIZE

As an aside, a number of observers have noted that there is a correlation between carrier size and carrier safety performance. This is demonstrated in Table 54. This likely is correlated with the fact that it takes time to grow, and they accumulate experience along the way. At some size many carriers also invest in a safety department.

- The largest carriers have the best inspection performance. Carriers with 300 or more power units performed quite well in the inspection measures. Carriers with 500 or more power units were even better, and carriers with 1,000 or more are better still.
- Further, the smallest non-new entrant carriers had poor performance in inspections.
- New entrant carriers had even worse inspection performance, demonstrating the continuing need for a vigorous (and vigilant) new entrant training, testing and enforcement program.

Table 54. Over and under expected value for the largest and smallest carriers and new entrants.

Measure	Comparative Driver OOS Rate	Comparative Vehicle OOS Rate	Comparative Driver Violation Rate	Comparative Vehicle Violation Rate
Interstate Carriers with 300 or More PUs (1,230 Carriers)	-2.99%	-6.99%	-6.84%	-14.53%
Interstate Carriers with 500 or More PUs (701 Carriers)	-3.07%	-6.90%	-6.79%	-14.33%
Interstate Carriers with 1,000 or More Pus (287 Carriers)	-3.29%	-7.15%	-6.76%	-14.55%
Recently Active Interstate Carriers with 5 or Fewer Power Units (435,594 Carriers)	1.26%	3.32%	3.07%	4.05%
New Entrant Entry Date in 2010	3.66%	4.09%	6.14%	6.99%
New Entrant Entry Date in 2011	4.20%	5.13%	6.74%	7.54%
New Entrant Entry Date in 2012	5.73%	6.92%	8.37%	8.96%

MULTIPLE DATA POINTS FOR POWER UNITS

The SMS algorithm uses adjusted power units as a measure of exposure. Consequently, MCMIS keeps track of, and provides SMS with, a range of different power unit attributes (or data elements), including:

- The number of power units that the carrier reported in their most recent MCS-150 filing (at the time of the extract).

- The number of power units that were shown in the MCS-150 that were active for the carrier 6 months prior to the extract.
- The number of power units that were shown in the MCS-150 that were active for the carrier 18 months prior to the extract.
- The average number of power units that were shown in the MCS-150 that were active in the prior 18 months.
- The carrier's adjusted number of power units. This reflects an adjustment used in SMS based on the nature of the carrier's vehicles and the reported number of miles per power unit.

Historically, the analysis was based on the number of power units shown in the most recent MCS-150, which is the most recent figure for power units. However, the opportunity arises to use the average number of power units over the prior 18 months, which FMCSA believes more accurately reflects the average number of power units that the carrier(s) had over the course of the period being analyzed.

Table 55 provides some comparisons between the number of power units for carriers with valid ratios (no more than five power units per driver) using the two data sources for trained carriers, for carriers that declined the training, for the control group, and for all recently active carriers in MCMIS in that line's category.

Table 55. Comparison of statistics for number of power units versus average number of power units—fewer than 15 power units.

Group	Trained Carriers	Declined Carriers	Control Group Carriers	Recently Active Carriers
Active (Interstate) Carriers - Fewer than 15 Average Power Units	170	444	8,375	489,190
Active (Interstate) Carriers - Fewer than 15 (Number of) Power Units	169	443	8,347	488,353
Active Carriers with Valid Ratios—Average Power Units	169	443	8,339	485,165
Total—Average Number of Power Units	364	808	17,563	1,222,605
Active Carriers with Valid Ratios—Number of Power Units	169	441	8,293	484,544
Total—Number of Power Units	368	796	17,712	1,221,396

For all groups, the total of the average number of power units was slightly lower than the total of the number of power units on the most recent MCS-150. For this study, there was no clear difference in the results regardless of which count of power units was used.

RELATION OF CRASHES TO GOING OUT OF BUSINESS

Table 56. Summary data for carriers with crashes.

Summary Data for All Carriers in Groups	Trained Carriers	Declined Carriers	Control Group Carriers
Crash Count	33	35	1,280
Crashes After New Entrant Entry Date	29	11	628
Total Carriers	204	578	11,561
Carriers Inactive in the Census	30	126	3,104
Crashes for Carriers Inactive in the Census	3	1	103
Average Number of Days Between Crash Date and Inactive Date	298	-760	286

A few additional explanatory notes:

- Among the trained carriers, two of the three crashes were for the same inactive carrier in the census. Apparently this company transitioned back to intrastate before going inactive. The third was an interstate carrier.
- The one crash for a declined carrier that was inactive showed an inactive date of November 8, 2010, and a crash on July 12, 2012. The contractor sent the introduction letter on their new entrant date—July 28, 2010.
- Among the control group carriers that had crashes and had a status of "Inactive" on the census and had crashes;
  - Four had crash dates after their inactive date. One was 3 days after their inactive date. The other 3 were between 120 and 226 days after their inactive date.
  - Two had a status of "Inactive," but no inactive date in MCMIS.
  - 16 went inactive between 2 and 99 days after their crash.
  - 18 went inactive between 107 and 196 days after their crash.
  - 16 went inactive between 214 and 272 days after their crash.
  - 18 went inactive between 302 and 393 days after their crash.

Overall, based on this limited data, the conclusion is that there is no pattern to suggest that either:

1. Crashes are a major reason that carriers go out of business.
2. There is a correlation that suggests that crashes are pushing the crashed carriers out of business.

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