PROOF OF CONCEPT FOR SIMULATION BASED RE-CERTIFICATION of COMMERCIAL DRIVER LICENSE

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16. Abstract

The severity of accidents involving commercial vehicles, along with the potential terrorist threats involving commercial vehicles, rising fuel costs, and tight budgets all demand today's drivers operate at their highest possible performance levels. Florida and the U.S. Department of Transportation have identified operator performance and safety as major objectives in addressing these inter-modal transportation needs of the state and nation. One of the most significant issues identified in this area is the challenge of commercial driver license (CDL) re-certification and a cost-effective method of identifying fraudulent CDL, issued either through purely illegal means or as a result of inadequate training; this situation also includes those who have been grandfathered into the 1992 CDL program from the previous program without any actual driver performance assessment. Currently, no performance based re-certification process exists to ensure the capability of the driving workforce or to provide diagnosis of potential problems, either from lack of experience, or improper training.The overall goal of our research is to explore and validate the application of computer based and simulation based technology to the commercial driving community. The objective of our initial research was to validate a newly developed virtual diagnostic test application that provides a valid, low cost process of determining drivers' skills and commercial vehicle knowledge. Research and development processes include various simulators and learning technologies to improve driver/operator safety and performance in the trucking and transportation communities. The conclusions from our research to date are that the VCRS is a valid assessment of the skills required to pass the current CDL test. The second phase of our research will look into the use of the VCRS as both a recertification test for the CDL and as a diagnostic tool for the trucking community. There were two main areas of testing that were measured: Simulation and CBT. The Simulation portion of the exam follows the CDL driving test by using a truck driving simulator to replicate the actual CDL process. The CBT portion of the experiment measures the knowledge base of the drivers, in particular: general knowledge, combination vehicles, hazardous materials, and air-breaks, and a walk around inspection. The goal of having the CDL test in computer based format is to establish a cost-effective way for the re-certification process.

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Overview

The severity of accidents involving commercial vehicles, along with the potential terrorist threats involving commercial vehicles, rising fuel costs, and tight budgets all demand today's drivers operate at their highest possible performance levels. Florida and the U.S. Department of Transportation have identified operator performance and safety as major objectives in addressing these inter-modal transportation needs of the state and nation. One of the most significant issues identified in this area is the challenge of commercial driver license (CDL) re-certification and a cost-effective method of identifying fraudulent CDL, issued either through purely illegal means or as a result of inadequate training; this situation also includes those who have been grandfathered into the 1992 CDL program from the previous program without any actual driver performance assessment. One of the major factors inhibiting the solution to this problem is the complexity and administration time required to conduct a CDL test in the traditional fashion. Although current US Federal DOT regulations preclude the use of simulation in the initial testing for the CDL, the regulations allow for the use of simulation and learning technology methods for supplemental training and testing.

The current CDL test consists of a multiple choice test (often pencil and paper), a Pre-Trip Inspection of a truck and trailer and a Basic Skills Driving Test that includes a set of maneuvers ranging from, shifting, backing and parking, normal street driving and highway driving.

Currently, no performance based re-certification process exists to ensure the capability of the driving workforce or to provide diagnosis of potential problems, either from lack of experience, or improper training. The current CDL is time consuming, costly, and only requires a written test for renewal. Drawing from the military and aviation community's experience with high-tech simulation interventions, along with previous efforts integrating simulation into the ground transportation world, the Center for Advanced Transportation Simulation Systems (CATSS) proposed a blended technology, diagnostic alternative using CBT and Simulation as a cost effective solution: the "***Virtual Check Ride (VCR)*** ".

This report represents the first phase of our VCR research efforts, which consisted of development of the application and initial validation efforts. The conclusions from our research to date is that the VCRS is a valid assessment of the skills required to pass the current CDL test. The second phase of our research will look into the use of the VCRS as both a recertification test for the CDL and as a diagnostic for the trucking community.

Introduction

The severity of accidents involving commercial vehicles, along with the potential terrorist threats involving commercial vehicles, rising fuel costs, and tight budgets all demand today's drivers operate at their highest possible performance levels. Florida and the U.S. Department of Transportation have identified operator performance and safety as major objectives in addressing these inter-modal transportation needs of the state and nation. One of the most significant issues identified in this area is the challenge of commercial driver license (CDL) re-certification and a cost-effective method of identifying fraudulent CDL, issued either through purely illegal means or as a result of inadequate training; this situation also includes those who have been grandfathered into the 1992 CDL program from the previous program without any actual driver performance assessment. One of the major factors inhibiting the solution to this problem is the complexity and administration time to conduct a CDL test in the traditional fashion. Although current US Federal DOT regulations preclude the use of simulation in the initial testing for the CDL, the regulations allow for the use of simulation and learning technology methods for supplemental training and testing.

The overall goal of our research is to explore and validate the application of computer based and simulation based technology to the commercial driving community. The objective of our initial research was to validate a newly developed virtual diagnostic test application that provides a valid, low cost process of determining drivers' skills and commercial vehicle knowledge. Research and development processes include various simulators and learning technologies to improve driver/operator safety and performance in the trucking and transportation communities.

The VCR focuses on the enhancement of operator's skills through the deployment of driver training simulation and advanced learning technology interventions. This is accomplished by using computer-based CDL general knowledge evaluations and computer-based table-top simulators, full motion simulators and non-motion simulators.

This program builds on several projects and activities done previously in support of CATSS mission objectives. One such project consisted of research into methods of certification of training for transportation applications using simulation as the training medium. (Tarr, June 2002) Another is an on going effort to look at alternative methods of visualizing roads and intersections, both to facilitate planning and situational awareness (CATSS & AT&T). It also builds on the community experience with the existing GE Mark II simulator located in the CATSS Lab in the UCF Engineering Building, which has raised the awareness of the ground transportation community to think of new ways to solve old problems.

The current CDL test consists of a multiple choice test (pencil and paper or computer-based), a Walk-Around Pre-Trip Inspection of a Truck and Trailer and Simulator Skills Driving Test. The required components of the *knowledge tests* that all CDL examinees must take are: General Knowledge, Air Brake Knowledge, Combination Vehicles

Knowledge, and soon Hazardous Materials handlin*g*. The required *skills* tests include: Pre-Trip Inspections, consisting of 105 inspection points and usually conducted on a driving range; and the two part driving portion, Basic Control, that includes a set of basic maneuvers conducted in a parking area including shifting, backing and parking, coupling and uncoupling the trailer, and a Basic Control Road Test, including normal street driving, highway driving and some extreme driving conditions, such as stopping on a hill. The entire CDL test can take 1-2 days to complete and includes no performance based re-certification only a written test. Due to the decentralized execution of the current CDL testing, replicating and validating CDL testing using current techniques have been very challenging.

"Creating a balance between humans and technology is essential in this effort. Simulation can incorporate many of the technologies described here today in [virtual] scenarios offering drivers the opportunity to successfully react to dangerous situations without the fear of loss of life, injury or expensive equipment damage."
(Formal Sponsor Briefing, Tarr 2002)

Simulations provide the opportunity for drivers to make decisions with logical consequences, providing the driver control of situations with which drivers would seldom be allowed to experience under normal situations. For example, the driver who has never driven on snow and ice can use a simulator to experience these driving conditions without injury to him or damage to the vehicle. Additionally, the driving scenario could provide a realistic "fish-tail" situation where the driver must be able to regain control of the vehicle without "jack-knifing."

The effects of simulations are revealed not by tests of knowledge but by tests of transfer and application (Thomas and Hooper 1991). Transfer refers to the driver's ability to apply his/her driving simulation experience in a new situation. It is believed that VCR, given some scenario changes according to situations, will be used to evaluate driver's skills while exposing him/her to extreme or unfamiliar driving situations. We believe the ability to use the VCR in this fashion will increase both perceptual fidelity and manipulative fidelity.

Virtual CDL testing methods

A virtual CDL test or Virtual Check Ride was designed to mirror the actual US Federal Department of transportation CDL test and its three major components. In addition, a formal after action review and feedback element was designed to provide a valid diagnostic process for evaluating and validating a driver's driving skills and general CDL required knowledge.

Table 1. The Four Phases of the "Virtual Check Ride"

PHASE I
Knowledge Test: 55 randomly selected test items taken from a bank of 500 questions on general CDL knowledge and vehicle specific knowledge. Criteria: 80% correct.

PHASE II
Pre-Trip Inspection: a virtual walk-around inspection of the 7 major inspection areas includes critical vehicle inspection components. Embedded faulty components verify if subjects know how to identify faulty equipment/components. Criteria: 80% correct

PHASE III
Simulation Ride: either mobile non-motion or stationary full motion simulator ride using the same driving scenarios demonstrating basic driving skills in a Road Test. Criteria: 80% driving accuracy and each portion.

PHASE IV
After Action Review: upon completion of the CBT portion of the Check Ride and another after completion of the simulation ride.

Virtual Check Ride simulation scenarios provide CDL drivers with immersed interactions including interactions with other moving vehicles, extreme weather and traffic conditions, freeway driving, inter-city driving, rural driving conditions, autonomous vehicle interactions in real-time situations, signalized intersections, and instructor control scenarios. Instructor controls include changing various variables such as terrain or road surface, weather, traffic conditions, tire blow-outs, wind direction and strength, and other variables as selected. The benefit of having an instructor, or in some cases a systems operator controlling variables, is the ability to test the driver on multiple situations during a real time simulation ride.

Technical Approach

In conducting the study that resulted in the Virtual Check Ride and its subsequent validation, several considerations were determined to be critical: mirroring the United States Federal Regulation; understanding the issues of the trucking community and what it considered critical success measures; a robust sample size; and finally a primary focus on driver performance with the technology being clearly a means to that end. The following research tasks were laid out to accomplish the research and validation of the ***VCR***.

Task 1: Conduct a Review and Analysis of Federal & State Directives and existing processes for current CDL test and establishment of criteria and measures of success for proper measurement of performance. Armed with the current specified driver performance requirements for the CDL, the research team looked at alternative techniques that could achieve the measurement needs in a minimal amount of time. Efforts included assessment, verification and examination of current operational or “live” systems, training systems, simulation systems, prototype systems, and any technology transfer initiatives. High quality motion and non-motion based simulation training and advanced learning technologies potentially useful to the truck driver training and operational community were examined for their utility and selection criteria, including as

top priority only those that are responsive to the established needs of enhancing driver performance.

Task 2: Under two previously related efforts, information on certification methods using simulation and a demonstration proof of concept for the prototype of a Virtual Check Ride were developed. The proof of concept package, similar to the traditional CDL test, consisted of a Knowledge Test and a pre-trip virtual inspection of a vehicle, followed by a simulated drive using the L3 I-Sim located at CATSS. This demonstration software was developed jointly between CATSS and Star Media, who have extensive experience in designing similar applications for advanced weapons systems in the military and commercial aviation. This demonstration material was reviewed by several Subject Matter Experts from the Transportation community, who had both operational driving experience and were certified CDL examiners. The results of this Proof of Concept were used as input to the next generation application. These elements were expanded into the operational version, based on implementation of the completed regulatory review, SME feedback gathered from the demo version and by formal expansion and establishment of an item bank of validated CDL knowledge test items. In addition, a formal set of CDL Driving Skills scenarios were jointly developed between CATSS and then L3 I-SIM, that were based on the Florida CDL Examiner's manual. The results of all these efforts were examined and integrated into the development of the operational beta version along with necessary Implementation Procedures that include the After Action Review process for the feedback session of the program.

Task 3: Validation of Prototype. Armed with the ***Virtual Check Ride*** prototype and the supporting Check Ride implementation procedures, consisting of the four part program, which was also a focus of the validation, to assess the CATSS study team began the multi phase validation process. This ***Virtual Check Ride*** includes a blend of technologies that meet the best mix of utility and technology, which was also a focus of the validation; to assess the quality and utility of the mix and achievement of desired outcome. In conjunction with industry partners, such as Roadmaster Driving School and the Florida Trucking Association representatives, the formal process of validation was conducted, utilizing both the fixed facility at CATSS and a portable component network set operated by the CATSS study team and trained members of the sponsoring organizations. This validation used a quasi-experimental design organized with the model developed previously under research sponsored by CATSS, (Tarr, Development and Integration of Certification Standards for Transportation Training Simulation Systems, June 2002) as well as reviewed for content and implementation by selected SMEs who are qualified CDL examiners. Feedback and evaluation data was collected routinely to ensure the quality and appropriateness of the training and to measure performance enhancements. Electronic records of the Virtual Check Ride were built into the prototype network, both for validation to document the success of the interventions and also for use as the basis for future research and to be used for AAR in the operational system.

Validation

There were two main areas of testing that were measured: Simulation and CBT. The Simulation portion of the exam follows the CDL driving test by using a truck driving simulator to replicate the actual CDL process. The ultimate goal of this is to validate the truck driving CDL simulator in comparison to that of the actual real-world truck driving CDL process. The CBT portion of the experiment measures the knowledge base of the drivers, in particular: general knowledge, combination vehicles, hazardous materials, and air-breaks, and a walk around inspection. These are the key testing areas of the actual CDL test, however in a computer-based, randomly generated format. The goal of having the CDL test in computer based format is to establish a cost-effective way for the re-certification process.

Content testing related to knowledge and skills necessary for safe driving was validated using 200 subjects from 6 different organizations along with samplings elements from various truck driving communities. Some of the key participants were: Frito Lay, CCC, Schenk and Roadmaster, (a certified private truck driving school). CCC provided a mixture of CDL school trained, self-study trained and motor carrier trained CDL certified and non-CDL certified subjects. Frito Lay provided strictly motor carrier trained and a 50-50 mixture of CDL certified and non-certified subjects. Roadmaster provided certified CDL school trained and CDL licensed subjects that consisted of drivers, instructors and SMEs.

It was expected that using qualitative, structured, and unobtrusive Quasi-experimental Design to validate the three categories (General Knowledge Assessment, Pre/Post Trip Inspections Assessment, and Vehicle Control Assessment) would result in (Concurrent) highly experienced subjects consistently scoring higher while those who were moderately skilled or not CDL certified (new drivers) consistently scored lower on both the CBT "Virtual Checkride" and GE I-Sim Road Skills Simulator. Content After-Action Review results validated this to be true as did (Concurrent) After Action Reviews.

Null Hypothesis

It is hypothesized that there is no relationship between scores on the VCR and scores on the CDL exam for *Novice* or *Expert* subjects. It is also expected that the average scores on expert subjects who are given pre-CDL treatment and those who do not receive pre-CDL treatment will be the same on the CDL average scores.

It was expected that empirical data collected using qualitative, structured, and unobtrusive Quasi-Experimental Design to validate the 3 categories (General Knowledge Assessment, Pre/Post-Trip Inspections Assessment, and Vehicle Control Assessment) would *not* result in (*Concurrent*) highly experienced subjects consistently scoring higher while those who were unskilled, moderately skilled, or not CDL-certified (*novice*) would *not* score lower on both the CBT Virtual Check Ride and GE-I SIM full motion Road Skills Simulator or the mobile FAAC SIM Road Skills simulator.

Data Collection Methods

Program Evaluation Standards- Utility, Feasibility, and Proprietary- were consulted.

- Randomly selected subjects from all three identified subject categories were interviewed.
- Observations of all three identified subject categories completing the Road Skills simulation tasks were recorded before and after completing the CBT "Virtual Checkride" portion.
- After Action Review CBT "Virtual Checkride" results were compared to the Road Skills Simulator After Action Review results.

Task 4: Once validation was complete, the Phase I technical report was produced to include recommendations for revisions and implementation. This process included Best Practices outreach for the Transportation Community, to include papers such as these presented at the Driving Simulation Conference Europe and the Interservice/Industry Education, Training and Simulation Conference. Continuous coordination with Florida Motor Carrier Compliance Office (primary sponsor) personnel as well as special members such as Florida Highway patrol enforcement, FTA members, and FDOT Division of Licensing has been accomplished. This was done to ensure both proper understanding of CDL needs and practical issues of administering the ***Virtual Check Ride*** and were part of the analysis, findings and recommendations that were formulated. One of the major elements of the final report has been consideration of ease of execution and cost-benefit of the ***Virtual Check Ride*** in providing a useful application. The ***Virtual Check Ride*** in the follow-on phase will be expanded into its diagnostic and training role and will be used as a major element of the continual expansion of the larger CATSS research agenda, focusing on the utility of simulation and advanced learning technology to enhance performance of all ground transportation personnel, such as transit and bus personnel.

Execution of the Virtual Check Ride System Research-Year One

After many hardware problems and some software learning curves, IST CATSS began the formal field trials phase of the CDL Evaluation and Validation at the end of December, 2003. The trials began with delivering the VCR (Virtual Check Ride) CBT (Computer-Based-Technology) systems and GE truck driving simulator, VSim, to Roadmaster Truck Driving School. The plan was to collect data from new students (no formal training or truck driving skills), graduated students (completed 160 hours of training), and also expert drivers (driving experience of plus three years). An attempt to collect data on new students who had no previous truck driving experience took more than 4 hours per participant, since the VCR became a training tool instead of a validation effort, a decision was made to collect data on graduating class members either prior to their CDL exam or directly after they completed their CDL exam. The time to complete both the CBT and Check Ride parts of the validation averaged nearly 2 hours per participant, with some exceptions based upon reading and language skills. It was discovered that scores from the VCR AAR (After Action Report) were nearly the same as

CDL exam scores. This could be an indicator that VCR CBT and simulator driving scenarios are valid tools to use both as diagnostics and possibly for training of the CDL. Based on these results alone the VCR could be an excellent addition to training for CDL exams.

The VCRS consists of computer-based (CBT) knowledge test phase, a walk-around testing phase, the check-ride phase on a driving simulator, as well as, phase IV, After-Action-Review (AAR) to track driver scores. The simulators, (phase III of the VCRS), used for this validation are: a single channel one monitor truck driving simulator the VS model 1000 and a three channel 180 degree Field of View (FOV) projection system auto simulator mock-up to the truck simulator. Both simulators ran the same software and driving scenarios and data collection procedures on both was the same. In addition, a desk top version was used for cost effectiveness parallel effort, but not for validation.

The validation process has involved establishing partnerships with several agencies and creating management plans for onsite data collection. Establishing and maintaining a positive relationship with the truck driving industry has taken a great deal of effort with weather, time and delivery driver schedule handicaps. However, with presentations and briefings, site visits, personal personnel support and procedural observations, we successfully brought several organizations on board for the validation study and a collective partnership for the overall VCRS research.

Throughout the year, we conducted on-site validation at Roadmaster, FritoLay, Schenck Distributors Incorporation, Commercial Carrier Corporation trucking and most recently Watkins Motor Lines Incorporation. It was decided that the data collection would occur on-site instead of participants coming to the UCF. This data collection process included extensive communications and logistical strategies along with a personalized management plan and support for each partnership.

Creating the VCRS

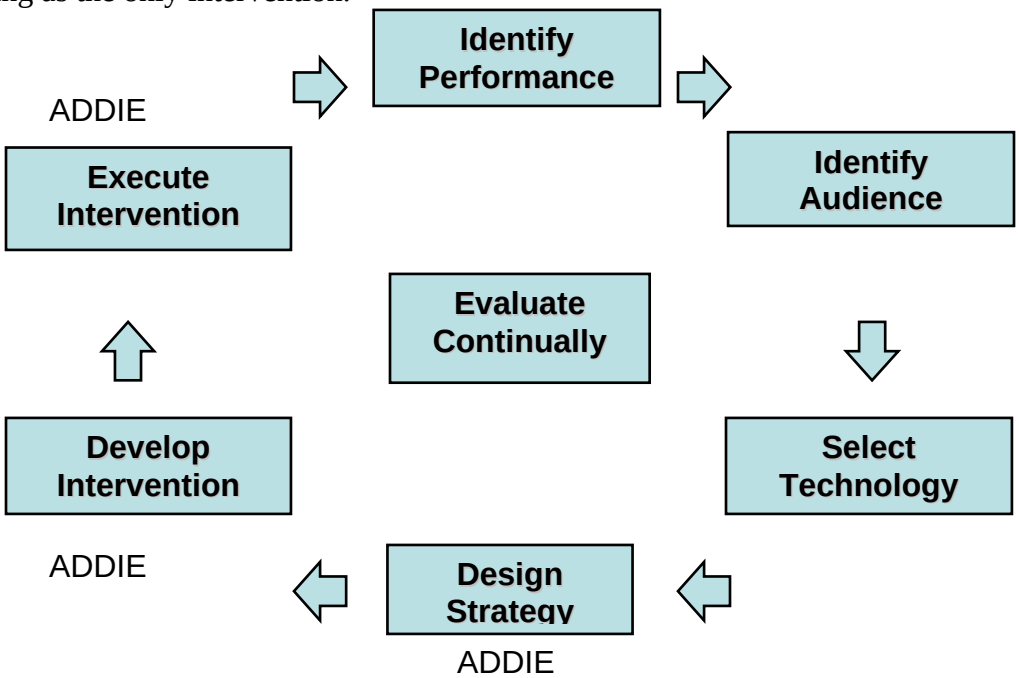
Our initial steps in creating the VCRS focused on gaining a strong needs-assessment and working closely with several subject matter experts to identify and define the problems at large. Once we identified the needs we turned to the traditional systems approach for creating our objectives and a simulated alternative to the CDL. The objectives closely match the CDL exam requirements. The systems approach at first glance appeared to offer exactly what we were looking for. There are three main characteristics of a systems approach:

- A systems approach is as scientific as it is empirical and must be able to be replicated
- A systems approach separates skills and knowledge into manageable parts
- The system is defined as a set of concepts or parts (objectives) that must work together to perform a particular function (performance and skills enhancement).

The ADDIE model is a systems approach training model. This model is an empirical process for designing training that is both efficient and replicable. The ADDIE model first breaks things down (skills and knowledge) into manageable parts (objectives). These objectives form the basis of the instruction, both in terms of content and assessment, ensuring accomplishment of the goals. Implementation and Evaluation are both guided by the objectives, making the process a controlled system.

The ADDIE Model

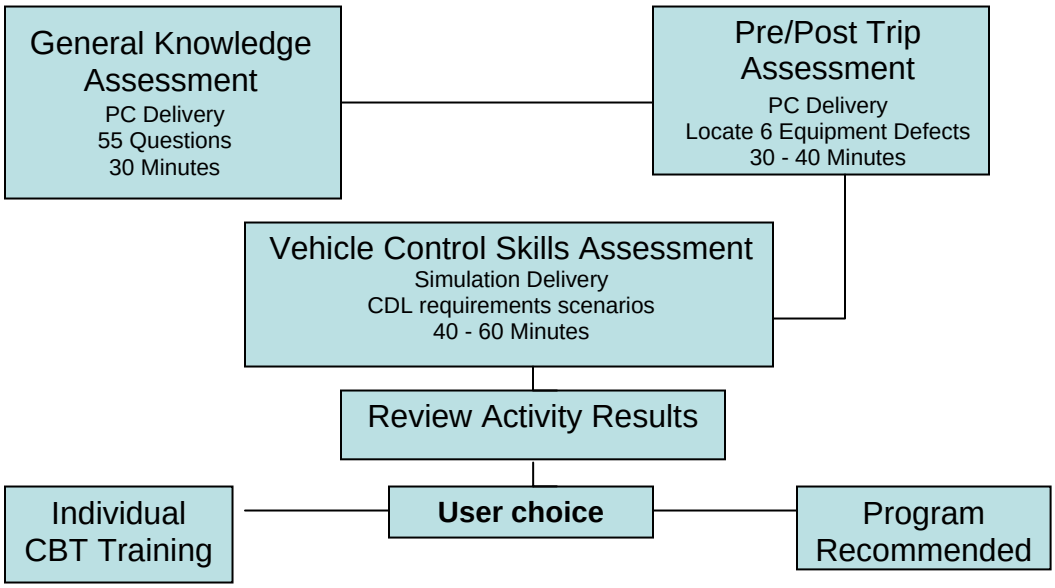
However, shortly after adopting this model, we realized that our system was more complex than what the ADDIE model could support. We needed something along the lines of the ADDIE model but something that also supported human performance. Thus we paired it with the theory of human performance technology (HPT). HPT aims to improve performance in the workplace or in learning situations by determining gaps in performance and designing cost-effective and efficient technology interventions. By marrying the two we created a hybrid model called the **Performance Technology Model**. Our model is a systematic approach, but takes a broader view; i.e., not limited to training as the only intervention.



Performance Technology Model

Once we had a strong model for our basis, we decided that a blended learning approach would be ideal. The blended learning approach consists of computer-based training (CBT) with built in feedback (AAR) and simulation (Check Ride). The CBT consist of 55 actual CDL test questions in four different knowledge areas: general knowledge, air brakes, hazardous materials, and combination vehicles. Questions are randomly selected

from a data base of 500 actual CDL test questions. The simulation portion is made up of basic skills, city, rural, urban, and freeway driving scenarios according to the CDL driving exam requirements. In each of the scenarios, a variety of driving skills are closely assessed by a third party examiner. Once the design was created, we developed the Virtual Check-Ride System prototype. After conducting extensive beta testing on a VCRS prototype we launched the VCRS validation experiment.



Flow Diagram of the Virtual Check Ride System

The VCRS validation experiment is a quasi-experimental design, due to the fact that we do not have a normal control group, but are comparing it to previous cohorts of drivers, considered to be equivalent except for our intervention. Our subject matter experts (SMEs) consisted of the training specialists and third-party examiners from the organizations where the validation experiment took place; therefore we opted to use them for the data collection process. Being that they are knowledgeable of the CDL and CDL examining system, we felt secure in their abilities to evaluate the driver. Furthermore, having the experiment on-site made scheduling of drivers easier and was therefore more convenient for all parties involved. The SMEs were trained in the operation of the VCRS systems operations and their skills in driver-assessment proved critical for maintaining a consistent data collection process.

The Experiment

There were two experiments conducted for the validation of the VCRS. The first experiment focused in on the performance and reliability of our system, the VCRS. While the second experiment compared and contrasted the scores of novice and expert drivers to see if there were differences in performance. In order to ensure we were measuring the system in terms of its ability to replicate the real word effectively, the validation study focused on system performance, while the second study looked at differences between

novice and expert driver performance where novice drivers are new CDL holders and expert drivers have been driving commercial vehicles for more than three years. In terms of evaluating the drivers, we opted to use the exact scoring method used by third-party examiners when they score driver performance for CDL exams. By adopting their scoring method we maintained consistency between our virtual system and the real world process.

Roadmaster truck driving school was the first organization where data was collected. We took the VS truck simulator to Roadmaster in February of 2004 and trained personnel on the safe operation of the simulator and the CBT system. As previously stated, we utilized their in-house third party examiners for data collection. While the VCRS was at Roadmaster, data from 32 participants was collected. For the validation, the examiners used actual CDL test data from Roadmaster student CDL exam records and compared it to the data from the Virtual Check-Ride System. The data showed that our system highly correlated with the actual real world exam process. This finding was crucial for the validation of the VCRS.

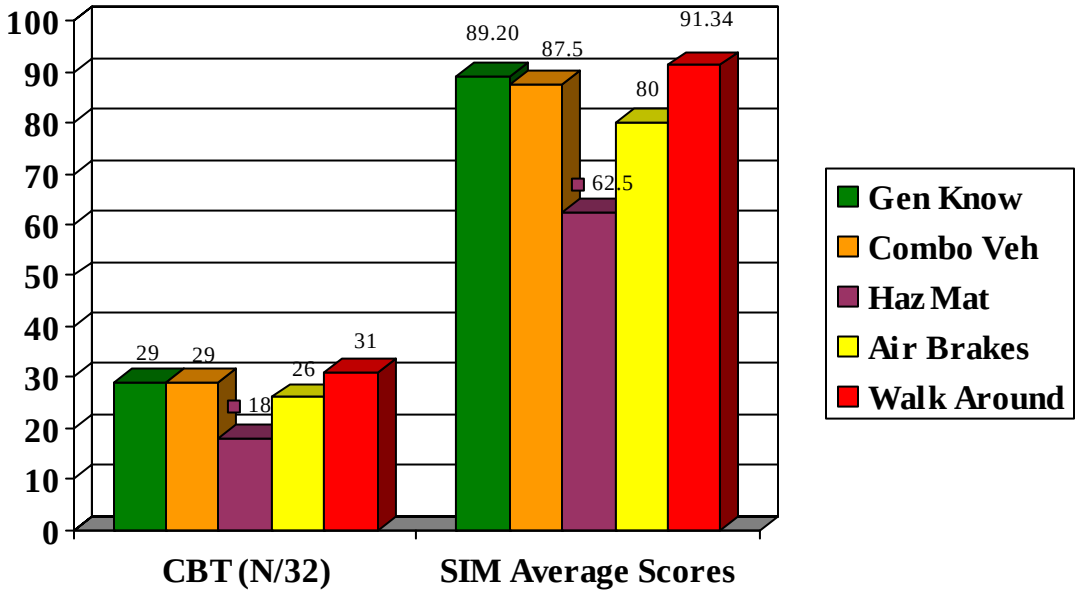
We did two driving comparisons, one for off-road test and one for on-road test. Our comparisons for the off-road test showed a high correlation: with an alpha level of .01, the strength of relatedness is high at .961 and our correlation between scores for the on-road test was also high, with an alpha level of .01, the strength of relatedness is high at .719. Roadmaster descriptive statistics are presented:

Sample Size: 32

23 completed the CDL simulation part
9 dropped out
Of the 23, all passed the CDL simulation part and all passed the Basic Skills Test

The computer-based training portion consists of general knowledge, air brakes, hazardous materials, combination vehicles and a virtual walk-around inspection. These questions mirror the CDL test but are presented in a computer-based format. A score of 80% or better is required to pass the CBT test. All of the drivers who we tested possessed their CDL, meaning they passed the actual test with an 80% or better. We tested the same drivers on our CBT with the following results are presented below:

These scores are consistent with what we expected to find. However, hazardous materials scores were low primarily due to the fact that general knowledge of hazardous materials was not part of the actual CDL test.



Once the data collection process was completed at Roadmaster, the system was then taken to FritoLay to gather information on expert drivers. With this information, a comparison was made between the novice drivers and expert drivers.

The process at FritoLay was much like that at Roadmaster. We were able to make use of their training specialist for our data collection process. This proved to be of great benefit for they are more skilled in truck driving and were able to provide pertinent feedback concerning the VCRS. FritoLay was able to run a total of 68 expert drivers through the system and their descriptive statistics and results are presented:

Sample Size: 68

50 completed the CDL simulation part
18 dropped out
Of the 50, 47 passed the CDL simulation part and all passed the Basic Skills Test

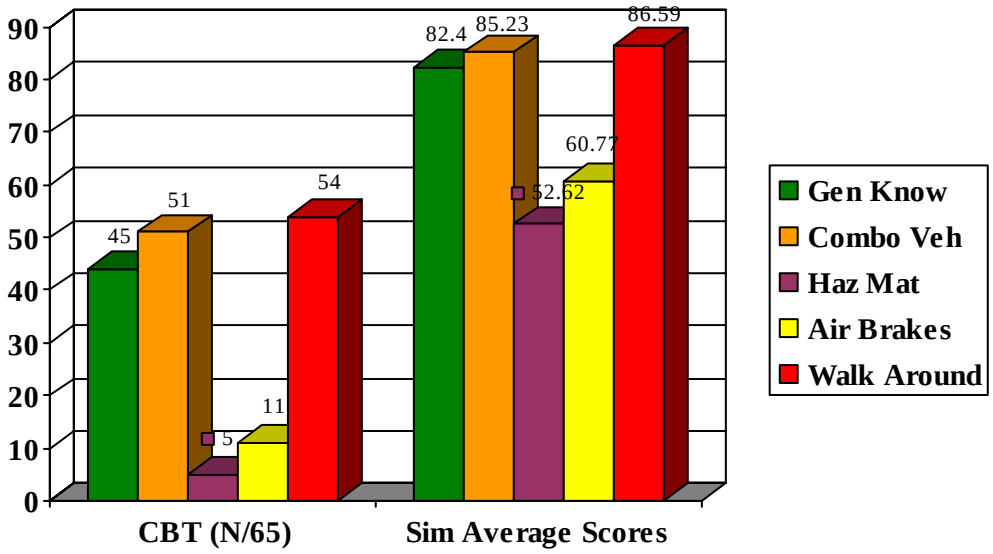
We compared the results between Roadmaster and FritoLay and found no major differences. An independent samples t-test was performed and revealed that there was **no significant difference between groups** for the following scenarios:

- **Brake Test** ($p<.05$, .359)
- **Off-Road Test** ($p<.05$, .316)
- **Urban Test** ($p<.05$, .776)
- **Freeway Test** ($p<.05$, .728)

Statistically significant differences exist between the Rural ($p<.05$, .045) and the City ($p<.05$, .001) driving scenarios. However, the Rural difference is a minimal (FL: 1.7, RM: .94), while for the City scenario, Group 1 (expert) drivers' means were 8.7 and Group 2 (novice) drivers' means were 5.0. These results are barely statistically

significant, but it's believed that they hold no real world relevance. Meaning that even though the numbers differ statistically they represent a minimal real world difference.

In terms of the CBT portion of the VCRS, the hazardous materials and air brake scores were statistically different between expert and novice. However, the hazardous materials section differed significantly, due to the fact that these drivers do not carry hazardous materials, and have limited knowledge on the topic. The air brakes show that the drivers of both groups have poor general knowledge on the topic, and upon further investigation with FritoLay, we found that there was a braking deficiency with their drivers which correlated with what our test found. Apparently they had a high number of minor incidents due to improper braking, and upon the completion of our study, they implemented a four hour refresher course on air brakes and have decreased their accident rate significantly. Listed below are the scores of the drivers on the CBT.



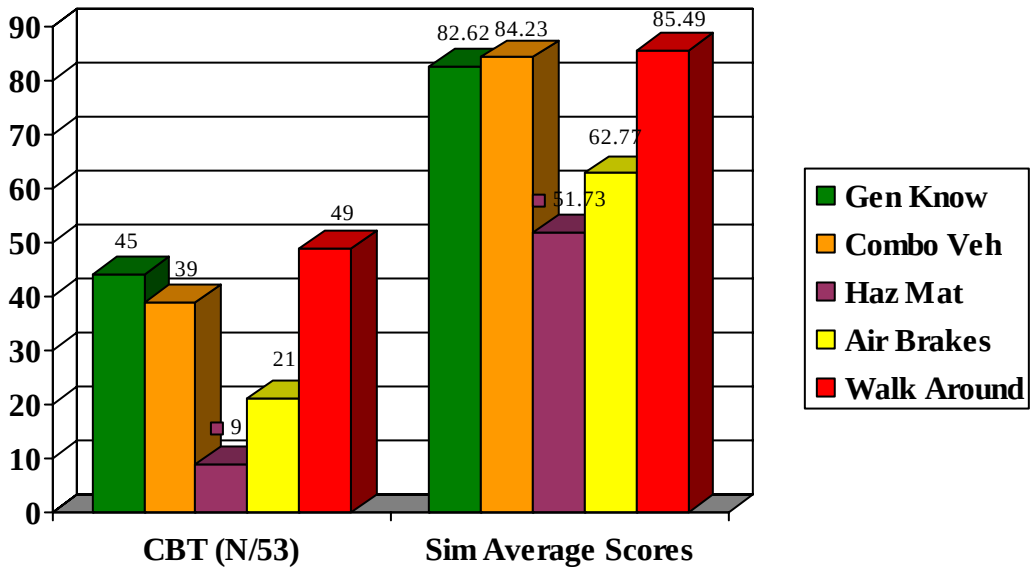
Overall, the novice drivers tended to do better than the expert drivers on the general knowledge section, but this was due to the fact that the novice drivers had just completed their CDL a week before and the material was fresh in their minds.

Recent Research Results

Recently we obtained access to a 180 degree field of view (FOV) simulator and have placed it at Schenck Distributors for data collection. This simulator will provide us with additional data about human performance in different simulators while at the same time do a cross system validation of our VCRS. The data collection process at Schenck is still underway, but currently they have run a total of 53 participants through the CBT portion of the VCRS and 32 have completed the entire experiment. Initial findings are showing that the performance is slightly better with the larger field of view, but this was expected.

We are continuing our data collection and will make a more formal report concerning the findings once it is completed.

Preliminary results indicate that Schenck CBT scores are indeed similar to the results from FritoLay and Roadmaster. Initial results for the CBT are presented:



Due to time and scheduling constraints with the drivers, 32 of the 53 have completed the entire VCRS. The rest are scheduled to complete the study at a future date. The beauty of the system is that the two sections can be run independently of each other and at different times since that they are testing two different things, knowledge and performance. Upon completion of the entire VCRS, the scores received will be compared and contrasted to the scores from FritoLay and Roadmaster. Currently, general comparisons are showing that the Schenck drivers are performing slightly better in the driving scenarios than both the FritoLay and Roadmaster participants, but further analysis of scores is required before any formal conclusions can be made.

Simulator Sickness:
There was roughly a 25% drop-out rate in the experiment per each group, but it is imperative to stress that simulator sickness alone can not be blamed. There were a variety of variables that contributed to the drop-outs. Many of the drivers opted out because they had been on the road for 11 hours and were too tired to sit down for a two hour experiment. Some of them were hungry or had other obligations to attend to, while some did report feeling of simulator sickness, roughly 10% per group. Overall the general feelings concerning simulator sickness were low. General feelings were indicated by using a five-point Likert scale. All reports were below a 3, which equals “moderate” feelings of simulator sickness. Below is the breakdown of the general feelings reported:

FritoLay: 18 opted out from the study
Roadmaster: 9 opted out from the study
General Feelings:
- **Eye Strain:** FritoLay: 2.6, Roadmaster: 1.8
- **Temperature Increase:** FritoLay: 2.1, Roadmaster: 1.7
- **Dizziness:** FritoLay: 2.2, Roadmaster: 1.4 **
- **Headache:** FritoLay: 1.3, Roadmaster: 1.3
- **Nausea:** FritoLay: 1.8, Roadmaster: 1.3

CBT Content Validity

The Virtual Check Ride Knowledge Test items comprised of CDL required driver knowledge items. They are said to have content validity after highly qualified subject matter experts reviewed and agreed that each test item is testing some element of knowledge that is necessary for safe operation of a commercial vehicle. These were compared to the existing test items used for the actual CDL test. The content was determined to be valid.

Although the Walk-Around is considered a Skills test on the actual CDL exam, we have combined it with the CBT portion of the Virtual Check Ride. The objective is to measure inspection knowledge prior to CDL certification, driver/employment assessments, or CDL licensing or re-certifications. Using Director to develop the pre-trip inspection interactions, the driver/student is able to "virtually" walk around the vehicle and "inspect" by zooming in to high fidelity digital photos that randomly display compliant or non-compliant depictions of the inspected area, i.e., Fan belts, mirrors, battery terminals, etc.

Simulation content validity

The scenarios built for each simulator were carefully analyzed and verified prior to development. Before building each scenario, SMEs were consulted. Terrain, interactivity, motion, response times, and variance of acceptance were considered.

Simulation *fidelity*, the level of realism that the simulator presents to the subjects, was included in the simulation content validation effort. Physical characteristics, visual display accuracy, spatial algorithmic values, kinesthetic, event validity (predicted responses), and other factors that ensure the simulation scenarios appear "real" without over-stimulation were again addressed during the simulation content validity study. We have found that a simulation environment that is overly stimulating caused subjects to "disengage" from the simulation intent. The best explanation we can give without further study is that over-stimulation causes distractions that actually defeat the purpose of the simulation exercise. It is suspected that this is due to the way humans process visual and spatial information in relationship to movement in time and complexity. In a simulation environment refresh rate and random movement are also factors for consideration when proving fidelity. We did not include these items in our study.

Although the simulators have different manufacturers and one is fixed base with motion and the other is mobile without motion, the scenarios used on both measure the same outcomes. Each scenario should be a valid indicator of a driver's skill, knowledge, and ability to perform in a satisfactory manner. Each scenario is used to detect the presence of driver's unsafe driving behaviors caused by weak driving skills, attitude, behaviors or a combination of these items. Scenarios can also be used for diagnostic purposes. They should provide managed identification of remedial or continuing educational needs to enhance the driver's capabilities. The Florida's CDL Examiners Manual is embedded in the performance measurements that each simulator records in the AAR report. Note: the scenarios were not designed to assess drivers' advanced skills.

Reliability

"Reliability is the indicator measuring consistency and dependability." The assessments used in both the Virtual Check Ride and the Road Test Simulation must be both reliable and valid if they are to properly support driver assessments and re-certification licensing decisions. With repeated assessments on some 500 plus subjects consisting of a mixture of highly qualified *experts* and minimally qualified *novice* drivers and students in similar conditions, *reliability* was determined through the consistency of results by comparing AAR assessment results. This is considered to be the test-retest method of validity. In a test-retest measuring reliability, two sets of scores are collected then correlated. It is believed that the time-frame between each test was sufficient.

The scores analyzed in this validation were found to have a high degree of correlation. The highly skilled drivers (*experts*) consistently scored higher on both the Virtual Check Ride and the simulation ride assessment. They also scored higher on the CDL re-certification exams. The minimally skilled drivers (*novices*) consistently scored lower than the experts on both the Virtual Check Ride and the simulation ride assessment. Their scores on the CDL exams were lower than the experts' exam scores.

Advantages And Disadvantages Of Using Quasi Validation Methods

In *concurrent* validity, determining the degree to which the scores of the two evaluations (although in this validation study they are the same but rewritten to appear as new questions) are in agreement can sometimes appear to be simplistic without the use of random assignment. The greatest *advantage* is the use of nonequivalent groups design. The groups were carefully selected. Each group's outcome was predicted according to existing knowledge and skills. As seen by the group assignments, anticipated lower scorers were placed in Groups 1 and 2, and higher score were placed in Groups 3 and 4. This method of validation also would work well with the interrupted time series designs.

Formal Collaborations /Concurrent Outreach activities of Research

England Briefing and Demonstration:
The UK has undergone several changes in the transportation research arena since 1996. The Transportation Research Laboratory (TRL) was the primary agency involved in

doing simulation research. However, due to changes they are now owned by the Transportation Research Foundation (TRF). This foundation runs more like a university in that it has four main directors, chief research scientist and over 500 employees. Andrew Parks is one of the chief research scientists. He has a background in Psychology and is currently in charge of a large scale investigative project focusing on truck driving skills. He and his team have recently completed a large scale study consisting of 600 participants who volunteered to be part of the study. They developed a study that focuses on the skills associated with getting a commercial truck drivers license in the UK. They use a blended learning approach in their study that consists of a CBT portion and a full motion simulator. The CBT section randomly chooses 35 questions that test a driver on general knowledge and other skills. This section parallels our CBT Virtual Check ride. They then move the participants from the CBT section to the full motion simulator that tests the driver's skills and once again, this parallels our design. The participants are tested on basic driving skills as well as braking, accident prevention, situational awareness, loading (hazardous materials), basic road traffic regulations, ergonomic principles, and what to do in emergency situations. Dr. Parkes is looking for collaboration between universities as well as places such as IST to assist them in their validation effort. The UK is facing many of the same problems that the US is facing when dealing with commercial truck drivers. We hope to continue future collaboration with Dr. Parkes's team at the Transportation Research Laboratory. This past September Ron Tarr did a site visit with Andrew in London to talk about collaboration.

Technical Paper published & Presented:
Driver Simulation Conference, Europe; Sep 2004, Tarr, R.W., A Virtual CDL Test: Can it be done?

Interservice/Industry Training, Simulation and Education Conference, IITSEC 2003 paper number 1323 Allen, Talleah & Tarr, Ronald (2003). Validation of a "Virtual Check Ride"; IITSEC, Dec 2003

Technical Abstract and Paper published and presented:
Interservice/Industry Training, Simulation and Education Conference, IITSEC 2004 paper number 1540 Allen, Talleah, Tarr, Ronald, White, John, Tanner, Scott, & Strebb, Christopher (2004). A Systems Approach to Simulated Alternatives For Commercial Drivers Licensing; IITSEC, Dec 2004

VCRS Hardware Improvement:

UCF Engineering Department – Talleah Allen Mentored/Project Management for five senior engineering design students. The project was to have the students design and engineer a special project for CATSS/IST. There were several engineering needs identified. Selected was to have the students design an inter-changeable steering system for the PC driving simulator. The steering system would replace an existing joystick

configuration thus making the simulator more realistic. We strongly believe that several CDL objectives can be completed on this level of simulator.

VCRS Software Improvement:

Multi Media/Digital Artists Department – Talleah Allen Mentored/Project Management for a graphic designer's internship student. Project, to develop models for the Schenck Distributor Corporation vehicles to be included in the vehicle dynamics used in the VCRS validation and further models development.

Rinker Concrete – vehicle model created for future scenario development for concrete truck drivers. Stress is placed on safety and roll-over.

POV (Private Owned Vehicle) driver's license scenarios being developed for measuring simulator usage as an alternative driving range exam along with several other applications.

Class B CDL exam scenarios, similar to CDL Class A validation, are being developed. Various research data will be collected for proof of concepts.

Advanced driving skills scenarios are being developed on the Patrol Simulator as well as the VS simulator. They will be retrofitted according to application and training or testing requirements and vehicle dynamics.

Additional Outreach & Collaborations:

Based on presentations at national conferences, the CATSS team was approached by South Carolina State University to consider a partnership in exporting the VCRS to South Carolina. As part of that, CATSS hosted a research meeting in Orlando to share information and potential research using the same model as was used in Florida. SCSU has a federally funded transportation research center similar to CATSS but has done no work in simulation.

In addition, a collaboration with Virginia Tech has been explored, under sponsorship of the Federal Motor Carrier Safety Agency, who is conducted a simulator validation study. Mr. Jerry Robins of FMCSA and Dr. Ron Knipling visited UCF to see about using the VCRS as a possible testbed for their research.

National Center for Simulation *High Tech Hob Nob* offered an excellent opportunity for the High-Tech-Corridor community to view the VCRS and various other driving simulator applications. Many great comments and development suggestions were greatly accepted.

Demo for several groups of UCF College of Education Instructional Design and Modeling and Simulation students provided an opportunity to show-case the VCRS and

to provide design and implementation lessons learned when designing complex mixed and blended learning environments.

A Video of the VCRS be conducted was made for in briefing of supporting companies and for use at future conference demonstrations.

Findings and Conclusions

This research utilized several simulation validation concepts centered on a Quasi-Experimental Design. It is believed that the data collected in this non-pure experimental study is an accurate representation of the intended criterion, to diagnose and validate CDL knowledge and skills and to add value to CDL re-certification.

We can reject the Null Hypothesis because we can infer that there is a relationship between VCR and CDL testing scores since Group 1 and Group 2 VCR and CDL exam scores fall within the acceptable average of each other. Additionally, we can infer that taking the VCR before the CDL testing will cause improvement on the CDL testing or re-certification even within the *expert*s groups.

Observations conducted while various groups of subjects completed the “Check Ride” phase of the VCR concludes our beliefs that using simulation can add value for those drivers who are preparing for their CDL re-certification and also for the *novice* driver just learning to drive a commercial vehicle. VCR is a cost-effective diagnostic and validation tools developed for identifying Commercial Driver License (CDL), re-certification knowledge and skills deficiencies. We called the tools “Virtual Check Ride” and Simulation “Road Test” ride.

Using blended assessment techniques, asynchronous computer-based training (CBT) and synchronous simulation based technology, data was collected and evaluated. Responses from questionnaires were used to form logical but random groups. Data collected from this validation study was also used as a major element of the continual of the larger CATSS research agenda which focuses on the utility of simulation and advanced learning technology to enhance performance of transportation personnel.

This report represents the first phase of our VCR research efforts, which consisted of development of the application and initial validation efforts. The conclusions from our research to date is that the VCRS is a valid assessment of the skills required to pass the current CDL test. The second phase of our research will look into the use of the VCRS as both a recertification test for the CDL and as a diagnostic for the trucking community.

ACKNOWLEGEMENTS

This validation study could not have been completed without the dedicated support of my VCRS Research team, (Talleah Allen, John White, and Chris Streb) and the expert assistance and advice of all the partners and co-sponsors of CATSS. A special thank you is extended to all participants of this study.

The views expressed herein are those of the authors and do not reflect the official positions of the organizations with which they are affiliated.

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Morris, C & Tarr, RW; Templates for Selecting PC Based Synthetic Environments for Application to Human Performance Enhancements and Training, Virtual Reality 2002, Conference, Orlando, FL, Mar 02

Sanders, J.R. (1994). The Program Evaluation Standards, *How to Assess Evaluations of Educational Programs*, 2nd Edition. New Delhi London, England: Sage Publications

State of Florida. (1998) *CDL Test Validity andReliability*.– CDL Handbook.

Tarr, R.W., Kincaid, P. Long, J.J. & McCloy, A. (2002). *Technical and Cost Proposal. Validation of a Simulation Based Re-Certification of the Commercial Driver License* The Virtual Check Ride.

Thomas, R. & Hooper, E. (1991) Simulations: An Opportunity We Are Missing. *Journal of Research on Computing in Education. 23(4) 497-513*

PROOF OF CONCEPT FOR SIMULATION BASED RE-CERTIFICATION of COMMERCIAL DRIVER LICENSE

Deliverable:

Final Report Appendixes

Experiment Introduction Letter	Form 1
Informed Consent Form	Form 2
Demographic Survey	Form 3
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Post Experiment Simulator	Form 11
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CDL Survey Form	Form 13

Number: _____

Center for Advanced Transportation Systems Simulation

Dear Participant:

The University of Central Florida, Center for Advanced Transportation Systems Simulation (CATSS) and the Institute for Simulation and Training (IST) are conducting research and development using simulators and computer-based technologies for diagnostic, testing, and training in response to the need to improve safety and performance in the trucking and transportation systems communities.

The Virtual Check Ride (VCR), was developed in response to the need to develop a cost effective diagnostic and commercial drivers license (CDL) validation system. The VCR addresses transportation safety and security by focusing on the enhancement of operator's skills through the deployment of driver training simulation and advanced learning technology interventions. This is accomplished by using computer-based CDL general knowledge evaluations and computer-based table-top simulators, full motion simulators and non-motion simulators.

The objective of this validation is to validate a diagnostic and/or retest Virtual Check Ride (VCR) system that provides a valid, low cost process of determining drivers' skills and commercial vehicle knowledge. We are evaluating and validating the VCR system not your overall performance. You will participate in the evaluation and validation of the system by completing surveys before and after completion of your participation, completing computer bases (CBT) general knowledge questions and Pre-Trip general knowledge questions. You will then help evaluate and validate the use of driving simulators and driving scenarios in the CDL process. No personal data will be collected. The result of this study will be published by several professional organizations.

Center for Advanced Transportation Systems Simulation

Informed Consent
Analysis and Verification of a Virtual Check Ride

General. Please read this consent document carefully before you decide to participate in this study. Upon completion of your reading it, please sign if you agree to participate.

Project title: Analysis and Verification of a Virtual Check Ride

Privacy Protection: University of Central Florida's Institute for Simulation and Training (IST), a partner with CATSS, maintains a secure records holding area that only those who need to know can access.

Purpose of the research study: To determine if the VCR is a reliable, valid and cost-effective system that could be used for diagnosing commercial vehicle driving knowledge and skills readiness prior to taking commercial drivers license (CDL) knowledge and driving exams. During this research study, we will also examine the difference between novice and experienced drivers pertaining to Virtual Check Ride Computer Based Training (CBT), the Check Ride on Simulator(s) either a mobile non-motion simulator and/or a stationary full-motion "Road Skills" simulator, against the traditional Commercial Drivers License (CDL) exam standards and requirements.

What you will be asked to do in the study: Fill out a demographic and informative survey and post simulator survey, participate in the Computer Based Training and operate the non-motion simulator and/or the motion simulator. You may also be asked to drive the table-top simulator during this study. You may be asked to video tape your simulator driving participation.

Time required: Up to three hours.

Risks: Possible Simulator sickness (sickness due to the visual effects of the simulator).

Benefits / Compensation: Potential benefits are: Increase your skills and knowledge of CDL rules and driving skills. The impact of reducing accidents and saving lives through the cost effective use of simulation, and an increased understanding of driver performance issues as well as increased employee awareness. There is no monetary compensation.

Confidentiality: Your identity will be kept confidential to the extent provided by law. Your name will not be used in any report nor will you be assigned a numerical identifier. Any data collected will not be used against you or your rights to obtain your commercial vehicle driving license.

Voluntary participation: Your participation in this study is voluntary. There is no penalty for not participating. There is no penalty for declining video taping should you be asked to tape your check ride.

Right to withdraw from the study: You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study: Ron Tarr or Talleah Allen at the Institute for Simulation and Training. 3280 Progress Dr., Orlando, FL 32826. The phone number is (407) 882-1300

_____I have read the procedure described above.
_____ I voluntarily agree to participate in the procedure.
_____ I have received a copy of this description.

_____/_____
Participant Date

Form (2): Informed Consent

Demographic Survey

1) Male____ Female____

2) Age ____

3) Have you operated a driving simulator or any other type of simulator before?

   Yes____ No____ If yes, please describe_____

4) Have you ever used a Desktop driving simulator? Yes____ No_____

5) Do you play video games? Yes____ No_____

6) At what age did you start playing video games? _____

7) If you use a computer, how many hours per week? _____

8) Do you have your CDL? Yes____ No _____ If yes, how long have you had your CDL? _____

9) Have you had any major accidents? Yes____ No____ If yes, please describe_____

10) Have you had any minor accidents? Yes____ No____ If yes, please describe_____

11) How long have you been driving a tractor trailer (total)? _____

12) Do you need glasses or contacts to drive? Yes_____ No_____

13) Are you wearing your glasses or contact for the simulator portion? Yes____No__

14) Is English your first language? Yes_____ No_____

15) Have you completed high school? Yes_____ No_____

SIMULATOR SICKNESS PRE-SCREENING QUESTIONNAIRE

This study will require you to drive in a simulator. In the past, some participants have felt uneasy after participating studies using the simulator. To help identify people who might be prone to this feeling, we would like to ask the following questions.

- Do you or have you had a history of migraine headaches? ☐ yes ☐ no
  If yes, please describe: _____
- Do you or have you had a history of claustrophobia? ☐ yes ☐ no
  If yes, please describe: _____
- Do you or have you had a history of motion sickness? ☐ yes ☐ no
  If yes, please describe: _____
- If you are a female, are you or is there a possibility that you might be pregnant? ☐ yes ☐ no

---

Form (4): Simulation Sickness Pre Screen

Number: _____

Brake Test

Low Pressure Warning Signal

Build Pressure and then Shut Engine Off___ Turn Electric Power On____ Fan Brake Pedal____ Air Pressure Signal comes on when Pressure reaches 60 PSI_____

Score: _____

Pop Valves

Release parking brakes___ Fan Brake Pedal____

Air Pressure Valves Pop Out when Pressure reaches 20-40 PSI_____

Score: _____

Rate of Air Pressure Build Up

Engine idling___ Air Pressure builds from 85 – 100 PSI in 45 seconds_____

Score: _____

Test Air Leakage

Fully Charged System___ Turn Off Engine_____ Release the service brake____

Time Air Pressure Drop____ Apply 90 PSI to brake pedal____

After Initial Drop air pressure should not drop more than 3-4 PSI in one minute____

Score: _____

Total: _____

Phase III
Check Ride
Start Time: _____

Number: _____

CDL 2 Off-Road

Stop Line (Bumper)

Smooth___ Full Stop_____ Attempts 1 2 3

Score: _____

Straight Line Back

Attempt 1:

Smooth___ Used Mirrors____ Idled Back_____ Number of Cones Hit: 1 2 3 or_____

Attempt 2: (Pull Up)

Smooth___ Used Mirrors____ Idled Back_____ Number of Cones Hit: 1 2 3 or_____

Attempt 3: (Pull Up)

Smooth___ Used Mirrors____ Idled Back_____ Number of Cones Hit: 1 2 3 or_____

Score: _____

Right Turn

Smooth___ Attempts 1 2 3

Score: _____

Alley Dock

Attempt 1:

Smooth___ Used Mirrors____ Idled Back_____ Successful_____ Flush to Dock_____

Attempt 2: (Pull Up)

Smooth___ Used Mirrors____ Idled Back_____ Successful_____ Flush to Dock_____

Attempt 3: (Pull Up)

Smooth___ Used Mirrors____ Idled Back_____ Successful_____ Flush to Dock_____

Score: _____

Parallel Park

Attempt 1:

Smooth___ Used Mirrors____ Idled Back_____ Successful_____
Number of Attempts____

Score: _____

Total: _____

Form (6): Off Road Scenario

City

Right on F Street

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Left on E Street

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Right on 9th Ave.

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Left on D Street

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Right on 8th Ave.

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Left on C Street

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Left on 7th Ave.

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Left on F Street

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Right into Pad

Traffic Check___ Used Signal____ Remain in Lane____ Used both hands_____

Deceleration_____Used Brakes during Turn____ Cancel Signal_____

Fully in Lane after Turn_____ Ran Over Curb_____

Score: _____

Form (7): City Scenario

Total: _____

Number: _____

CDL-3 Urban

Bridge Clearance on Overpass

Driver remembered Clearance_____

Score: _____

Urban Driving

Traffic Checks___ Spacing____ Maintains Lane_____ Speed____

Score: _____

Curve Left

Traffic Checks___ Speed Entering____ Speed During Curve ____

Maintains Lane _____

Score: _____

Curve Right

Traffic Checks___ Speed Entering____ Speed During Curve ____

Maintains Lane _____

Score: _____

Total: _____

Number: _____

CDL-3B Freeway

Freeway Onramp

Traffic Checks ___ Initiate Signal ____ Cancel Signal _____ Speed Entering____

Maintains Lane _____ Use of Mirrors _____

Score: _____

Lane Changing to Left

Traffic Checks ___ Initiate Signal ____ Cancel Signal _____ Maintains Lane _____

Use of Mirrors _____

Score: _____

Lane Changing to Right

Traffic Checks ___ Initiate Signal ____ Cancel Signal _____ Maintains Lane _____

Use of Mirrors _____

Score: _____

Freeway Off Ramp (exit)

Traffic Checks ___ Initiate Signal____ Cancel Signal _____ Speed Entering____

Use of Mirrors _____

Score: _____

Total: _____

CDL 2B Rural

Railroad Crossing with HWL

Law___ Stops____ Traffic Check____

Score: _____

Drive Upgrade

Keep Right___ Safe Speed____Traffic Check____

Score: _____

Stop/Start on Upgrade

Smooth___ Space Management____ Stop Line____ Full Stop_____ Traffic Check____

Deceleration_____

Score: _____

Drive Down Grade

Right Lane___ Brake Check____ Safe Speed____ Braking_____ Traffic Check____

Score: _____

Stop/Start on Downgrade

Smooth___ Space Management____ Stop Line____ Full Stop_____ Traffic Check____

Deceleration_____

Score: _____

Railroad Crossing without HWL

Law___ Stops____ Traffic Check____

Score: _____

Rural Driving

Traffic Checks___ Spacing____ Maintains Lane_____ Speed____

Score: _____

End Time:

_____

Total: _____

Form (10): Rural Scenario

Post Virtual Check Ride Questionnaires

Carefully read each question. Check one answer block for each question.

Question	**Strongly Agree**	**Some What Agree**	**Agree**	**Some What Disagree**	**Strongly Disagree**
The gauges seemed realistic?					
The simulator, "Virtual Check Ride" could prepare drivers for the CDL exam.					
After completing the simulated driving portion of this assessment, I feel CDL testing using simulators are a realistic alternative to the conventional approach?					
After completing the simulator "Virtual Check Ride", I feel truck simulators are an efficient training tool?					
The computer-based portion of the assessment was realistic?					
The pre-trip examination was realistic and tested pre-trip items?					
The simulated driving section of this assessment was too long?					
I would recommend "Virtual Check Ride" for those interested in preparing for their CDL or CLD re-certifications.					
The simulated driving section of this assessment was too short?					
The side view mirrors need adjustment?					
The brakes stopped in the right amount of distance?					
Knowledge test questions accurately tested what I need to know to pass my CDL tests.					

Form (11): Post Experiment Sim Survey

Number: _____

POST-EXPERIMENT SIMULATOR INDUCED DISCOMFORT (SID) QUESTIONNAIRE

To verify the extent of SID occurrence, we are tracking the severity of any discomfort felt by those who drive in the driving environment simulator.

During this most recent experience in the driving environment simulator did you experience any feelings of discomfort? Please rate your feelings on a five-point scale.

My overall eye strain was:

1----------2----------3----------4----------5
None Low Moderate High Severe

My overall temperature increase was:

1----------2----------3----------4----------5
None Low Moderate High Severe

I experienced dizziness:

1----------2----------3----------4----------5
None Low Moderate High Severe

I developed a headache:

1----------2----------3----------4----------5
None Low Moderate High Severe

I felt nauseous:

1----------2----------3----------4----------5
None Low Moderate High Severe

Opinion Items – Design and Delivery Attitude

Carefully read each question. Check one answer block for each question.

Question	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. This course helped me learn where systems are located on the vehicle.					
2. The classroom materials prepared me for my commercial truck drivers license (CDL).					
3. After completing the driving portion of this course, I feel I am a safer operator of commercial vehicles					
4. After completing the simulator “Virtual Check Ride”, I feel I am ready to complete the on-road driving skills test.					
5. Tables, figures, and enclosures provided sufficient support in preparing me for my CDL or CDL re-certification tests.					
6. Knowledge test questions accurately tested what I need to know to pass my CDL tests.					

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. The course should have more interactivity and simulator time so I can practice applications of theories and driving skills.					
8. I think the simulator ride taught me how to react to safety issues.					
9. I would recommend this course for those interested in preparing for their CDL or CLD re-certifications.					
10. My learning style is "I must do it to fully understand and remember."					

Drivers: Your comments and suggestions would be greatly appreciated!

_____

_____

_____

_____

_____

_____

_____

Thank you for participating in this important study.

Form (13): CDL Survey Form