CDL Data Quality Assessment

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Commonwealth of Kentucky

CDL Data Quality Assessment

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October 2020

1. Report No. KTC-20-33/RSF81-1F	2. Government Accession No.	3. Recipient's Catalog No	
4. Title and Subtitle CDL Data Quality Assessment		5. Report Date October 2020	
		6. Performing Organization Code	
7. Author(s): Valerie Keathley-Helil, Mallory Brown, Andrew Martin, Abraham Najarzadeh, Brian Howell, Jennifer Walton		8. Performing Organization Report No. KTC-20-33/RSF81-1F	
9. Performing Organization Name and Address Kentucky Transportation Center College of Engineering University of Kentucky Lexington, KY 40506-0281		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. RSF 81	
12. Sponsoring Agency Name and Address Kentucky Transportation Cabinet State Office Building Frankfort, KY 40622		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplementary Notes Prepared in cooperation with the Kentucky Transportation Cabinet			

16. Abstract

Quality issues related to commercial driver license (CDL) data present ongoing challenges to state and federal transportation agencies. This study highlights several problems with CDL data, including a lack of standardization for state-specific traffic infractions; process and workflow difficulties that degrade the accuracy, validity, and timeliness of data; adjudication procedures that can potentially mask serious violations from CDL driver history records; inadequate recordkeeping in state law enforcement citation and court case management software applications; outdated mainframe systems in urgent need of upgrades; IT personnel who are not paid enough; and insufficient reporting requirements for federal agencies that issue traffic citations. Best practices states can adopt to resolve these issues include undertaking renewed efforts to standardize state traffic infraction codes and equivalency tables; increasing automation of data entry and reducing repetitive data entry processes; amplifying outreach efforts to law enforcement officials, prosecutors, and judges that are focused on the federal guidelines which govern the adjudication of CDL-related infractions and their application to driver history records; including a CDL indicator in citation and adjudication software so that researchers and analysts can better track how CDL-related traffic are handled; increasing investments in new IT systems as well as personnel recruitment and retention; and improving coordination between federal agencies and the Central Violations Bureau so that traffic citations are reported to state agencies quicker.

17. Key Words Department of Vehicle Regulation, customer satisfaction, employee satisfaction, performance metrics		18. Distribution Statement Unlimited with approval of the Kentucky Transportation Cabinet	
19. Security Classification (report) Unclassified	20. Security Classification (this page) Unclassified	21. No. of Pages 65	19. Security Classification Unclassified

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Executive Summary

During past research projects, Kentucky Transportation Center (KTC) researchers found it extremely difficult to verify whether state driver licensing agencies (SDLA), law enforcement agencies, and court systems are complying with 49 CFR Parts 383 and 384. Research was persistently hampered by the poor quality of data on traffic convictions related to commercial driver licenses (CDLs). Substandard data quality is the product of three issues: 1) Many state courts lack CDL-specific case disposition data, 2) SDLAs rely on aging computer systems and manual processes to update Commercial Driver License Information System (CDLIS) records, and 3) Commercial motor vehicle (CMV) safety technologies used by law enforcement capture little information about drivers. Measuring the efficacy of the Federal Motor Carrier Administration's (FMCSA) CDL regulations for improving highway safety and quantifying safety trends can only be done with access to better-quality data. Key stakeholders (e.g., administrators, law enforcement, court officials, FMCSA auditors, researchers) must be able to trace the activities of different agencies and have access to accurate and timely data. They should also be able to trace CDL convictions beginning with pre-screening and proceeding through subsequent actions, including inspections, citations, court actions, and changes to records in CDLIS to ensure that each CDL conviction adheres to the requirements of 49 CFR 383 and 384.

This report lays out a roadmap that state transportation agencies can use to improve data quality, evaluate their performance, and supply data on CDL issuance, enforcement, adjudication impacts, and safety outcomes. By surveying and convening a working group of stakeholders to discuss issues with software applications and database technologies, guidance is put forward on upgrading information technology (IT) infrastructure and improving tools to track CDL issuance, enforcement, adjudication, and status changes. Agencies must first identify data quality issues hampering their databases and determine how those problems impact their ability to carry out their mission as well as effects on partner agencies. States can prioritize data quality improvement efforts by identifying issues that most threaten highway safety. Given that many states face daunting challenges related to funding, it is important for this process to be cost-effective.

Although many state agencies use antiquated computer systems, proven measures exist for improving CDL data collection, storage, and analysis. Each approach is necessary but cannot serve as a standalone solution for improving CDL data quality. Funding is required for each of these strategies to be successful, and agencies must prioritize locating funding mechanisms to shore up CDL data quality. Integrating CDL data can strengthen data quality by improving the accuracy and completeness of data. Alongside data integration, improved data collection methods should be used to reduce error and administrative efforts by agency personnel. Implementing license scanners and e-citation software helps eliminate errors which result from manual data entry and can expedite adjudication processes, thereby improving timeliness and accuracy. Yet data integration and advanced data collection methods also require the expertise of highly skilled IT personnel.

In state court systems unified case management systems (CMSs) are used to standardize and centralize court case data, which bolsters their quality. Unified CMSs deployed statewide, regardless of court and jurisdiction, improve efficiency when courts transmit court case data to partner agencies (e.g., SDLAs, law enforcement). A unified CMS also lets stakeholders track a CDL-related violation from citation through disposition and the CDLIS update to verify a state complies with CDL regulations. However, there are many variations between states due to differences in state court structures. Some states have statewide, unified CMS systems while others let individual courts determine the CMS system.

Some agencies have innovated their workflow processes to account for the lack of data integration with other agencies and insufficient knowledge of compliance with CDL regulations at partner agencies. For example, Kentucky's SDLA has added two reports to their daily workflow to preserve CDL data quality and comply with regulations. Staff use these reports to identify instances of masking in CDL-related cases that make their way through Kentucky's state court system. This has helped Kentucky prevent over 200 instances of CDL conviction masking.

Hiring and retaining highly qualified computer and information research scientists is crucial for carrying out the processes needed to improve handling of CDL data. However, it is difficult for public sector agencies to offer competitive salaries to these scientists. To attract qualified professionals, public agencies must adapt to the needs of the current workforce and identify ways to incentivize them (e.g., flexible work schedules, opportunities for advancement).

Best practices are presented which SDLAs can use to improve CDL data quality, strengthen agency performance, and ensure that law enforcement and court systems comply with federal regulations. The American Association of Motor Vehicle Administrators (AAMVA) needs to work with states to improve the AAMVA Code Dictionary (ACD) equivalency standardization. States also need to enhance their CDL data quality metrics. E-citation and court CMSs must include a mandatory CDL/CMV indicator as this makes it easier for analysts and policymakers to track CDL enforcement and adjudication. SDLAs can reduce data entry errors through automation, streamlining processes, and adopting better reporting standards. States should up their investments in information infrastructure and the personnel who are responsible for the maintenance of CDL-related records. Increased monitoring and outreach to courts, prosecutors, and law enforcement by SDLAs will increase awareness of and compliance with federal CDL regulations and requirements. Finally, FMCSA can help by coordinating with federal agencies and the Central Violations Bureau to accelerate reporting of traffic infractions on federal lands to state driver record bureaus.

Chapter 1 Background and Literature Review

1.1 Background on Commercial Driver's License Laws and Regulations

The Commercial Motor Vehicle Safety Act of 1986 (CMVSA) sought to remove unsafe commercial vehicle drivers from public roads by creating minimum licensing standards and establishing federal authority over their licensing. CMVSA mandated consistent enforcement of commercial vehicle regulations across all 50 states and required states to implement licensing programs, which included commercial learner permits (CLP), commercial driver licenses (CDL), and knowledge and skills tests for CDL applicants. Before the CMVSA, there was no centralized collection of driver history data, and a driver who had a poor driving history record in one state could obtain a license in another. As a result of the reforms mandated under the CMVSA, two regulations were added to the U.S. Code of Federal Regulations: 49 CFR Parts 383 and 384. The requirements of these two regulations have evolved over time.

1.2 49 CFR 383 and 384

According to the Electronic Code of Federal Regulations (ECFR), 49 CFR Part 383 addresses the responsibilities of motor carriers and drivers (EFCR, 2020). A motor carrier cannot employ a driver who does not have a current CLP/CDL with the proper class or endorsements. An endorsement lets a driver operate certain vehicles or haul materials following testing. A restriction prevents a driver from operating particular vehicles. Motor carriers are also barred from employing drivers with a disqualified CLP/CDL, those who possess more than one CLP/CDL, commercial vehicle operators who have violated laws pertaining to railroad-highway grade crossings or have been issued an out-of-service order by law enforcement.

Commercial vehicle drivers can only obtain a CDL after earning a satisfactory score on a written knowledge exam and a skills exam. Besides passing the required exams, drivers must also submit an application, a self-certification form indicating the type of vehicle they will be driving, and obtain a current medical exam certificate. Drivers are must also inform their employer in writing within 30 days of receiving a citation for a moving violation. If a driver's license is revoked, suspended, canceled, or disqualified, they must inform their employer by the end of business on the following day. Companies must require prospective employee drivers to submit a 10-year driving history during the application process.

The responsibilities of state driver licensing agencies (SDLA) are found in 49 CFR 384 (ECFR, 2020). States are responsible for implementing the knowledge and skills tests for CLP/CDL and administering CDL licensing for commercial vehicle drivers. SDLAs must obtain multiple documents and perform required database checks prior to issuing a license. First, the SDLA must check to ensure the driver does not possess a driver's license from any other state and, if necessary, refuse to issue a license until the driver surrenders all active driver licenses. The SDLA is required to check the Commercial Driver License Information System (CDLIS) and the CDL holder's 10-year driver history record before renewing, upgrading, or transferring a license. If the required record searches uncover negative information that would result in a disqualification, the SDLA must change the license status and begin the disqualification process. SDLAs must also check the self-certification for all drivers and obtain a medical certification if the individual indicates on their self-certification form that they want non-exempted interstate driver status. Before issuing the license, the SDLA must also obtain a digital image or photograph that other SDLAs can verify. Finally, SDLA agents must update CDLIS if a CDL is issued, identification information changes, or the issuing state changes.

SDLAs also have required timeframes for reporting changes to CDLs and CLPs (ECFR, 2020). The reporting requirements of 49 CFR 384 are shown in Table 1. The table lists the timeframes for required record checks and updates. If a license is being issued to a driver who does not currently have a CDL in that state, the licensing agency must check the driver record no earlier than 24 hours before issuance. For a renewed, duplicated, or upgraded license, the SDLA must check records no earlier than 10 days before issuance. For reinstatement, the licensing agency must check driver records no earlier than 24 hours before issuance. If a state disqualifies a license with another State of Record, the state disqualifying the license must inform the State of Record within 10 days of disqualification. If a CDL driver receives a violation for an offense other than parking, weight, or vehicle defect, the state must inform the state of record within 10 days of the conviction. If a state requests a driving record from another state, that state must comply with that request within 30 days. In terms of medical certification, if a driver is non-certified, the state must update CDLIS within 10 days of expiration. If the FMCSA sends a state update about the issuance or renewal of a variance, CDLIS must be updated within 10 days. If a driver receives medical certification or variances for a medical condition, CDLIS must be updated within 10 days.

Table 1.1 CDL Transactions and Timeframes Specified in 49 CFR 384

CDL Transaction	Timeframe
New Issuance	Check driver records no earlier than 24 hours before issuing the license.
Renewal, Duplicate, Upgrade to a new class or a new endorsement	Check driver records no earlier than 10 days before issuing the license.
Disqualification	Notify state of record within 10 days.
Traffic violation of out-of-state CDL/CLP holder other than parking, weight, or vehicle defect	Notify state of record of violation within 10 days of the conviction.
Receive request from another state for a Driving Record	Fulfill request within 30 days.
Driver non-certified	Update CDLIS within 10 days of expiration
FMCSA sends state update about issuance or renewal of a medical variance	Update CDLIS within 10 days.
Receive medical certification or variances	Update CDLIS within 10 days.

1.3 Penalties for Non-Compliance

49 CFR 384 includes penalties for states that do not meet the CDL licensing and oversight requirements. CDL programs of states which do not meet CDL mandates can be decertified, which can result in the loss of federal highway funds and Motor Carrier Safety Assistance Program (MCSAP) funds. On the first day of non-compliance, a state can lose up to 5 percent of Federal Highway Administration (FHWA) funding and 10 percent of MCSAP funding. Decertification prohibits a state from issuing, renewing, transferring, or upgrading CDL/CLP licenses. While the agency rarely decertifies states for non-compliance, FMCSA has stated that it intends to increase sanctions leveled against non-compliant states (FMCSA, 2008).

1.4 AAMVA Code Dictionary (ACD)

Each state maintains its conviction reporting language and codes based on its own statutes and regulations. Kentucky, for example, uses specialized codes known as the Uniform Offense Report (UOR) codes. The CMVSA requires states to develop CDLIS interfaces for the centralized state driver license information system administered by the American Association of Motor Vehicle Administrators (AAMVA) to ensure that a driver only has one license from one state. CDLIS lets states maintain a complete driver history record for each CDL and CLP holder and report convictions for out-of-state drivers electronically. The patchwork of language and codes would be a challenge for developing this system.

To bridge this gap, AAMVA developed the American National Standards Institute (ANSI) D-20 code set. ANSI D20 was a standardized set of codes states used to exchange information regarding convictions and withdrawals (AAMVA, 2020). ANSI D-20 eventually became the AAMVA Code Dictionary (ACD) (AAMVA, 2017). ACD codes are used in CDLIS to help states report conviction type or the reason for a license withdrawal (AAMVA, 2017). Jurisdictions use ACD codes on AAMVAnet, a secure network developed by AAMVA, which allows SDLAs to exchange messages with each other (AAMVA, 2020). As of 2018, there are 260 ACD codes.

AAMVA officially replaced the ANSI code set on November 4, 1996 (AAMVA, 2013). From April 1997 through November 2018, AAMVA updated the ACD code set 14 times. An ACD code update involves adding, clarifying, and revising codes based on the needs of jurisdictions as well as evolving federal regulations (AAMVA, 2017, 2018). For example, when convictions for railroad-highway grade crossing violations became a disqualifying offense in 2002 as required by the Interstate Commerce Commission Termination Act (ICCTA) of 1995, AAMVA updated ACD codes

to reflect these regulations. ACD codes were also revised to reflect the Motor Carrier Safety Improvement Act (MCSIA) of 1999 (AAMVA, 2018). In 2011, AAMVA added ACD codes for violations involving handheld devices and texting while driving (AAMVA, 2018). AAMVA also issues updates to ACD codes based on recommendations from member jurisdictions (AAMVA, 2013 and 2018).

An ACD code update consists of adding a new code or revising an old code. An update can also specify which codes have been retired in CDLIS (AAMVA, 2013). AAMVA has retired 152 codes since 2005. When the ACD code dictionary is updated, AAMVA releases an implementation guide and manual. These documents describe the code revisions, reason(s) for the revisions, required changes to the programming language, the date each change becomes effective, and the relevant federal regulations that the codes support. When AAMVA releases ACD code updates, jurisdictions are responsible for

- Ensuring their agency applies the updated codes to driver records,
- Updating their manuals,
- Providing training to their employees, and
- Implementing the new application code in their motor vehicle agency system (AAMVA, 2013).

Once the jurisdiction receives the ACD code update, it must revise the programming logic and perform necessary testing to ensure that each code have been changed correctly in the system.

1.5 Description of ACD Codes

ACD codes identify the specific conviction or withdrawal that transmitted in an AAMVAnet message. An ACD code consists of a letter and two numbers. For example, D45 denotes failure to appear for trial or court appearance (AAMVA, 2018).

ACD codes are categorized by the type of violation or withdrawal applicable to the code (AAMVA, 2013). The first letter of the ACD code indicates the conviction category. Table 2 contains the meaning of the first letter in the code and its corresponding category. The third column contains the types of convictions that fall under that category. This information is based on the categories published in the 2018 AAMVA Code Dictionary Manual Version 5.2.2.

Table 1.2 ACD Codes and Categories

Codes	Category	Related Convictions
A	Alcohol and drugs (controlled substances) violations	BAC, DUI, possession of controlled substance, ignition interlock devices, transportation of a controlled substance, and underage drinking
B and D	Duties failed – requirements not met – improper behavior	Hit and run, driving on a revoked license, driving without insurance, driving without a license, operating a CMV without a CDL or CLP, operating a CMV without the proper class endorsement, violating license restrictions, failure to pay, failure to appear, and misrepresentation
E and F	Equipment/vehicles – regulations, defects, and misuse	Operating a vehicle with equipment required by law, not using equipment required by law, failure to use restraints and protective equipment, and stopping, standing and parking.
M and N	Maneuvers – illegal or improper (m and n codes)	Failure to obey traffic control devices, failure to stop at railroad tracks, following improperly, improper lane or location, improper passing, reckless, careless, or negligent driving, failure to yield, failure to signal, improper turns, driving the wrong way or wrong side

S	Speeding	Speeding in excels of miles per hour and racing
U	Unclassified Offenses	Evading arrest, resisting arrest, vehicle homicide, vehicular manslaughter, vehicular feticide, using a CMV to traffic persons, use of a vehicle in the commission of a felony

ACD codes also have a 12-character abbreviation that serves as a description of the code and a definition for the code (AAMVA, 2013). Table 3 shows an example of an updated ACD code from 2013. Based on this example, W82 is a new ACD code used to indicate a conviction where a driver failed to surrender their license or permit when it was administratively withdrawn.

<p align="center">Table 1.3 ACD Code Table Example</p>

ACD Code	Code Status	ACD Abbreviation	Definition
W82	New	FTS LIC/PERM	Failure to surrender a license or permit when directed by jurisdiction

Withdrawals in CDLIS often contain an ACD code for a conviction to explain the reason for the withdrawal. However, some ACD codes are reserved for withdrawals (known as Withdrawal ACD Reason codes) and indicate second or third convictions (AAMVA, 2018). Some ACD codes require additional information about the conviction (known as the Conviction Offense Detail). This is the case for DUI convictions when the agent must indicate blood alcohol level. Conviction Offense Details are also required for speeding tickets because the CDLIS entry must indicate the number of miles over the speed limit. In the case of failure to appear and failure to pay, an additional ACD code is used in the details to indicate the underlying conviction or citation that led to the failure to appear or failure to pay.

Three other important flags must accompany an ACD code to complete a conviction. The first is the CMV Indicator, which is used when the conviction involved a commercial vehicle. The second is the Hazmat Indicator, for convictions where the vehicle was transporting hazardous materials. The third is the Citation CDL/CLP Holder, which indicates whether the driver had a CDL or CLP when they were issued the citation. If any of these flags accompany an ACD code, it shows that CDL regulations and penalties apply to the conviction (AAMVA, 2018).

States do not have to use ACD codes for their motor vehicle agencies systems, but they must use them when sending messages via CDLIS. AAMVA uses equivalency tables that match ACD codes to each jurisdiction's violation and conviction codes. When AAMVA updates the ACD, it uses ACD Equivalency Tables to gauge how those changes could affect the overall ACD system and jurisdictions. At one point, AAMVA published the equivalency tables and distributed them to the jurisdictions. However, states are now charged with updating their equivalency tables. As with most requirements not supported by a federal mandate, some states comply, but others do not. This results in data quality issues with out-of-state convictions and can force motor vehicle agency staff to research conviction codes to apply updates to CDLIS (Keathley-Helil, Martin, and Walton, 2020).

ACD codes were created for states to exchange conviction and withdrawal data. However, ACD codes are also used in the Problem Driver Pointer System (PDPS) in the National Driver Registry (NDR). The NDR is a division of the National Center for Statistics and Analysis within the National Highway Traffic Safety Administration (NHTSA). NDR records contain personally identifiable information (PII), including name, date of birth, gender, driver license number, and reporting state. When a motor vehicle agency searches for a driver in NDR, the PDPS pointer indicates the state of record, which is the jurisdiction from which the driver obtained their license. The PDPS system stores information about drivers whose driving privileges have been revoked, suspended, canceled, denied, or who have been convicted of serious traffic-related offenses. Also, members of the Driver's License Agreement (DLA) require a DLA code, which is equivalent to the ACD code.

1.6 Literature Review

1.6.1 The Current State of CDL Data Integration among Law Enforcement, Courts, and SDLAs

Researchers and practitioners have worked to establish standards for court adjudication, data management, and data reporting. *New Trends in Advanced Traffic Adjudication Techniques* (1976) presented recommendations on facilitating changes in the administrative structure of courts, or establishing courts of special jurisdiction, to handle traffic cases in a faster and more judicially consistent manner by eliminating criminal distinctions for most traffic offenses, allowing pre-payable citations, expediting trials, and improving rehabilitation programs (e.g., traffic school). More recently, research has focused on improving data collection efforts at law enforcement agencies as well as electronic file standards and management for state and local court administrators (Wiliszowski, 2011; *Traffic Records Program Assessment Advisory*, 2012; Raaen, 2017). This research has generated copious technical documentation describing *how* states should tackle data collection. Nevertheless, stakeholders continue to lack sufficient information about *why* numerous roadblocks to the vertical and horizontal integration of these core systems for purposes of data extraction, research, and analysis persist. The reasons for the lack of seamless integration are numerous. Differences in institutional structure, laws and policies, technical capacity, and resource availability all impede or hinder data integration.

Many states lack databases that link traffic citation, adjudication, and disposition data. It is very difficult in many cases to trace a citation from its issuance to its submission to the SDLA. Kentucky Transportation Center (KTC) researchers have encountered these hindrances on research projects. One KTC study documented uneven enforcement and adjudication of CMV/CDL-related offenses around the state. However, explaining the disparities and practices leading to such outcomes was difficult because the research team could not obtain records linking citations to final adjudicative dispositions (Martin et al., 2015). Table 4 summarizes some constraints on data connectivity between the six core data systems. In other instances, these details are readily available public knowledge or based on reports in other documents. The table lists constraint types (or category), describes constraints, and gives examples of states with each type of issues.

Table 1.4 Core Data System Constraints and State Examples

Constraint Type	Constraint Description	Example State(s)
Structural/ institutional	State lacks unitary court system	MT, NV, AR
	Stack lacks uniform, electronic state traffic citation database	MN
	State does not have centralized BMV or DMV Model	AL, KY
	State does not maintain or share up-to-date ACD Equivalency Table	OK
Legal/policy	Difficult to contact state court administrator	SC
	State will not release data to non-residents	VA, AK, TN
	State does not require uniform case management standards	MO
	State is reluctant to release citation-to-adjudication-linked data	KY
	Injury surveillance data difficult to obtain due to health privacy laws	All states
	No state mandate or data system	SD 15 others
	Traffic citations are not classified similarly among the states	All states
Technical	State traffic database only reports aggregate numbers, not case-specific	FL, GA
	Outdated mainframe, difficult to interface core systems	Several states
	GIS data difficult to link to point data	Several states
	Difficulty matching across common fields in core systems	Several states
	State does not collect vital data, such as a CDL/CMV Indicator	DE, MI, MN
Financial	Charge for programming custom data reports	WA, UT
	Do not have resources to provide programming, have public tool for queries	WI

Structural and institutional challenges are possibly the most difficult to address. A significant challenge faced by several states (e.g., Montana, Nevada) is the lack of a unitary state court system. Without this, states do not have the

authority or technical capacity to track or report case-level data. The same holds true of state law enforcement agencies, which sometimes lack a unified state traffic citation repository in which all citations are electronically reported. At the time a 2011 NHTSA report was released, some states still issued a percentage of traffic citations in a paper format rather than electronically. In contrast, others have databases delineated along agency lines, where local departments or specialized divisions (e.g., a state highway patrol or commercial vehicle enforcement unit) submit citations to a centralized database (Wiliszowski, 2011). As of 2015, only 63 percent of law enforcement citations in Minnesota were electronic. In fact, 181 law enforcement agencies in Minnesota were still issuing paper citations (*Statewide eCitation Study*, 2015).

Some states have adopted a centralized BMV or DMV model, while others have implemented less centralized systems. Kentucky has county clerk offices that issue vehicle registrations, while its circuit court offices issue driver licenses. Both organizations operate at the county level. Kentucky has 120 counties, which translates to 240 independent local agencies involved in vehicle registration and driver licensing. While the state has a centralized repository of driver and vehicle data, driver and vehicle records are stored in separate systems. In Alabama, driver licensing responsibilities fall under the Alabama Law Enforcement Agency, whereas vehicle licensing is handled by the Alabama Department of Revenue. States have traditionally enjoyed considerable discretion with respect to recording traffic offenses in databases. Some use statutory references, whereas others have specialized codes (e.g., Kentucky and Uniform Offense Report (UOR) codes). The AAMVA sought to bridge this gap by creating the ACD, so that the state of issuance could apply traffic out-of-state traffic citations to a driver's record.

Several laws and policies make it very difficult for researchers to obtain citation and adjudication data. Previous work by the research team has found that some states are hard to reach because there is no public-facing contact information for state court database administrators or law enforcement database administrators. Some states, such as Virginia, do not release certain kinds of court data to non-residents (Savage, 2013). Other states, like Missouri, give local court systems the option of selecting from among several case management software and hardware options, increasing the difficulty of compiling state-level data. In Kentucky, the Kentucky State Police and Administrative Office of the Courts have the technical capacity to release case-level citation-to-adjudication records throughout the state. But in practice, they have been reluctant to release data with case-specific information to non-parties. Generally, only police officers, layers, and those cited have been granted access without an agreement between both agencies and a memorandum of understanding (MOU) that places strict limits on permissible data use(s).

Although NHTSA guidance for reclassifying traffic citations has existed for decades, some states have been slow to follow adopt the agency's guidelines. This is why, in the *State Court Guide to Statistical Reporting*, the Court Statistics Project instructs states to "report a felony caseload violation as part of the criminal caseload, rather than with the Traffic, Parking, and Local Ordinance Violation caseload" (Schauffler et al., 2017). Depending on a state's proclivity to decriminalize traffic offenses, it may be challenging to compare traffic dispositions across states due to lack of uniform reporting. Reporting very much depends on the distribution of civil penalties and misdemeanors in each set of state statutes.

Daunting technical hurdles exist as well. For most states, the best-case scenario is obtaining summary statistics of specific charges along with their final dispositions. In general, this is because states lack the technical capacity to provide citation-to-adjudication case-by-case histories, even if they do not have policies that prohibit supplying that level of detail to researchers, practitioners, and analysts. State databases may not be especially adaptable. The outdated mainframe systems many states rely on are not easy to customize for other interfaces. For example, Kentucky's driver and vehicle information systems — the Kentucky Driver License Information System (KDLIS) and Automated Vehicle Information System (AVIS), respectively — are more than 20 years old and use COBOL, an outdated programming language. Custom reports must be built to allow for data linkages, while actual integration or communication among systems is barely possible, if at all.

Some state databases lack common fields to match records across systems, which is necessary for analysts to accurately merge data across systems. Or, if the systems do contain common fields, they are not ideally suited for matching. One of the challenges of matching vehicle records to driver records in Kentucky is that vehicles are often registered to a spouse or relative, and not the individual operating the vehicle. Often, the cost-benefit calculus of updating a system to collect more data or developing a new system does not justify a change. Transitioning from proven albeit dated mainframe databases to server- or cloud-based alternatives is often fraught with technical

difficulties. In a few instances, these challenges have been insurmountable, leading states to abandon system upgrades altogether.

In other cases, states do not collect vital data. When researching CDL enforcement and adjudication outcomes as part of a forthcoming study, KTC researchers learned that many states do not have an indicator on their e-citation which specifies whether the driver has a CDL endorsement or was operating a CMV. In those states, analyzing commercial vehicle enforcement and adjudication outcomes is virtually impossible, even if they have unified citation and adjudication databases with robust data reporting functionality, because they cannot separate CDL/CMV citations and dispositions from non-CDL/CMV dispositions. Delaware, Michigan, and Minnesota reported this problem, although the latter two were in the process of adding a CDL indicator as of 2017. Utah has a CDL indicator on its citations, but it is not a mandatory field, and officers frequently forget to mark the CDL indicator box on the form.

Financial constraints are also central to the problem. Despite these databases playing an expanding role in how DOTs issue credentials, manage workflows, develop long-term strategic plans, enhance analytical capabilities, and optimize the distribution of resources, many state legislatures do not prioritize electronic infrastructure. While CDL non-compliance can be quite costly for a state and highway safety should be a top priority, states often use funds for more visible projects such as road construction. In addition, many states address funding shortages through cuts to government agencies (e.g., motor vehicle agencies). Dwindling federal and state transportation revenues resulting from stagnant fuel taxes and improving vehicle fuel economy accentuates this problem. Many state court administrators do not supply court data unless the party requesting the data agrees to pay the programming costs and, in some cases, any printing and distribution expenses. Database analysts in Washington and Utah informed KTC researchers of such a policy when they attempted to collect traffic records related to the adjudication of CDL/CMV-related traffic offenses. These costs constrain many researchers' ability to obtain necessary data for analyses related to court adjudication. Another state — Wisconsin — has developed a public-facing XML-based application to retrieve court records. This approach to resource constraints is somewhat innovative, but analysts and researchers not familiar with XML, or the application will have great difficulty extracting data.

In addition, no standardized coding system exists for law enforcement to report traffic offenses in databases. States use a variety of coding systems to indicate violation types. Some states use statutory references on a citation to indicate specific violations, while other states use specialized codes. This makes it difficult for an SDLA to translate traffic violations for out-of-state citations into their own system's coding. ACD code equivalency tables help bridge this gap. However, AAMVA does not regularly update this reference, and states are responsible for updating their state tables. Not all states can do this. As a result, SDLAs must spend valuable time researching citation codes or contacting states directly to process out-of-state tickets.

1.6.2 The Court System and CDL Data Quality
Under 49 CFR 383.51, CDL holders are disqualified if they are convicted of major offenses, serious traffic violations, railroad-highway grade crossing violations, or out-of-service orders (ECFR, 2020). Given that CDL laws are meant to keep unqualified drivers from obtaining or maintaining a CDL, states must remove disqualified CDL holders from the highways. Courts play a vital role during the conviction process. Ensuring that courts correctly adjudicate and report the outcomes of hearings involving CDL traffic violations to SDLAs is critical for maintaining the quality of data used by CDLIS and CDL programs. Each offense results in periods of disqualification that vary in length. 49 CFR 384 also includes provisions for court systems, which instructs them on how to adjudicate violations involving CDL holders (ECFR, 2020). Courts, through correctly adjudicating cases involving CDL holders, are often the deciding factor in preserving public safety.

49 CFR 384.226 prohibits judges from masking convictions (ECFR, 2020). Masking involves many of the same tactics described in Carnegie et al. (2009), such as plea bargains to avoid suspension of driving privileges. Masking tactics are used to keep moving convictions off of a driver's CDLIS record to avoid disqualification ("Masking and Other State Court Challenges," 2012). To qualify as masking, the action must occur following a hearing and conviction. Examples of masking include allowing a driver to pay court fees, then dismissing the charge; reducing a charge; vacating the conviction and sentence; or sending a driver to traffic school (National Judicial College, 2016). Many of these sentencing tactics, such as traffic school diversion programs, are perfectly acceptable for standard license holders, but they are illegal for CDL holders.

According to legal experts, judges choose to engage in masking for multiple reasons. Judges and prosecuting attorneys receive very little training on CMV regulations. Some judges do not encounter many CDL cases in their courtroom and therefore lack adequate experience in their adjudication; they are not aware that these sentences are illegal (FMCSA and AAMVA, 2008). Some judges mask convictions to help a CDL holder avoid losing their job (Masking and Other State Court Challenges, 2012). This is particularly true in an area where trucking is a large industry (Masking and Other State Court Challenges, 2012).

Judges and court systems also fail to meet CDL requirements in other ways, primarily when they do not report convictions to the SDLA within the 10-day reporting requirement (Witte, 2011). This is an especially problematic issue for judges and courts in rural areas, which can lack a centralized communication system tying them into state and local agencies ("Masking and Other State Court Challenges, 2012).

An FMCSA task force also found problems with law enforcement practices, which prevent judges and prosecuting attorneys from having all relevant information about a driver to properly adjudicate cases involving CDL holders (AAMVA and FMCSA 2008). Judges rely on information written on the citation to determine the facts of the case. Because judges cannot access CDLIS, they are not even able to confirm whether the defendant is a CDL holder. A law enforcement officer can fail to indicate the defendant has CDL class license, the state code corresponding to the federal CDL regulation, or whether the defendant was hauling hazardous materials at the time of citation (Shea, 2014; Witte, 2011). In some cases, this is the result of human error. However, AAMVA and FMCSA found that errors in citations also stem from issues with the National Law Enforcement Telecommunications Network (Nlets) and CDLIS. Nlets is a data network consisting of law enforcement, criminal justice, and public safety-related information. These databases do not always provide up-to-date or accurate information, and SDLAs do not always report information in a timely manner to these data warehouses (AAMVA and FMCSA, 2008).

Based on these factors, judges inadvertently put the public at risk since accidents involving CMVs cause more damage and have higher fatality rates than non-CMV crashes (Fritschner, 2013; Witte, 2011; Wright, 2006; McBeth, 2014). Research shows that traffic violations people generally view as minor infractions are in fact linked to crashes over the ensuing year, including failure to or improper signal, improper passing, and speeding more than 15 miles over the limit (Shea, 2012). In addition, judges jeopardize state compliance through improper adjudication and not meeting the 10-day reporting requirements (Shea, 2014; Witte, 2011).

Solutions to this problem frequently involve making procedural changes prior to traffic court hearings. The FMCSA recommends judges and prosecutors require asking the defendant to present their license to determine if they hold a CDL. Courts also need to encourage law enforcement to make a note of CDL licenses on the citations ("Masking and Other State Court Challenges," 2012). An FMCSA task force suggested that the agency put more funds toward training judges on diversion, masking, hardship licenses, and the importance of appropriately adjudicating cases involving CDL holders. The task force further recommended that FMCSA embark on a judicial outreach program to help judges and prosecutors understand the importance of meeting the 10-day reporting requirements (FMCSA 2008). The same task force recommended that law enforcement receive additional training in writing citations for traffic stops involving CMVs.

Technological solutions could help with this problem. The 2008 FMSCSA Task Force proposed funding a case management information system for court systems (FMCSA 2008). A funding source could also be developed to improve the interface between CDLIS and Nlets so up-to-date CDL data can be accessed, and to develop electronic citation software that includes a section indicating if a CMV was involved in the citation (FMCSA 2008).

1.6.3 Data Quality
Quality data have several characteristics. They are:

- Accurate, meaning values input into a system align with those stored in the system;
- Timely and, therefore, up-to-date (Ballou and Pazer, 1989; Tayi and Ballou, 1989);
- Complete, meaning all data elements are in the database (Ballou and Pazer, 1989; Tayi and Ballou, 1989);
- Consistent, meaning data are the same throughout the database and all integrated databases (Ballou and Pazer, 1989; Tayi and Ballou, 1989); and
- Standardized, meaning that duplicate records have been removed and the formats for the data fields are standardized so data can be compared easily (Ballou and Pazer, 1989; Tayi and Ballou, 1989).

Another data quality factor that sometimes can be found in the literature is *authoritativeness,* meaning the user has confidence that the data are correct, and that they can make an informed decision based on that information (Forbes Insights, 2018).

Wang and Strong (1996) encourage organizations to view data quality in the same vein as product quality. Raw data are refined to create an information product similar to the way raw resources are used to create a product (Wang, 1989). However, data cannot be depleted as raw materials can (Wang, 1989). Data can be reused multiple times for multiple purposes. Data quality is something that must also be improved over time to better meet customer needs, and management must be committed to those efforts as well as committed to maintaining data quality (Wang and Strong, 1996).

1.6.4 Why Does Data Quality Matter?

Ultimately, organizations use databases to answer questions that guide decision making. Using bad data can result in higher risk decision making, which can be costly and dangerous (Forbes Insights, 2018). Good data quality lets end users feel confident they can make good decisions based on the data they are given (Moreno, 2017). Poor data quality increases the amount of time needed to make a decision and limits a manager or staff member's ability to analyze the data and take full advantage of them (Lock, 2016).

Good data quality also increases productivity as it decreases the amount of time that workers spend on verification and correcting errors (Moreno, 2017). Staff members can then focus on their core job functions more. Bad data quality can also impair an agency's ability to comply with those regulations (Moreno, 2017). In the case of the CDL mandate, being non-compliant can cost a state agency millions of dollars and prevent it from issuing CDLs to qualified drivers. According to Moreno (2017), bad data also result in missed opportunities; a missed opportunity in the context of CDLs can lead to unqualified drivers on the highways and therefore reduce highway safety. Bad data can also have a deleterious effect on a whole database. An error in one segment of the database can spread wherever that data are used.

1.6.5 Improving Data Quality

Despite organizations frequently saying that data quality is important, it is often not prioritized or budgeted for unless an emergency arises that highlights the importance of data quality (Tayi and Ballou, 1989). Not everybody in an organization buys into data quality initiatives, and when they do commitment to data quality improvement wanes over time (Forbes Insights, 2018). I.T. departments are generally tasked with improving data quality, but often, the problems rest within the organization's business practices, which I.T. personnel cannot fix (Forbes Insights, 2018).

Data are increasingly integrated to make business decisions. Data warehouses, which are central locations where data from different databases are stored, have been critical to this development (Tayi and Ballou, 1989). With multiple integrated data sources, data errors could affect multiple databases (Tayi and Ballou, 1989; Forbes Insights, 2018). Also, there is increased use of soft data in these systems, which are data that cannot be verified easily. Soft data include opinions, ideas, and experiences. Hard data can be objectively measured (e.g., numbers or demographic data). It is more difficult to ensure data quality with soft data (Tayi and Ballou, 1989; Ballou and Pazer, 1985). It is also much more challenging to address data quality when the input data are qualitative, such as law enforcement citations in the case of CDL datasets.

Several scholars say that context matters significantly in data quality. When an organization decides to address data quality, they need to identify which data are most troublesome (Tayi and Ballou, 1989). In multiuser environments, end users have different data quality needs for the same data. Wang and Strong (1996) encourage organizations to consider quality from the viewpoint of the data consumer and their intended use cases. Organizations should ask users what they think constitutes data quality. Wang and Strong (1996) found that data quality studies often focus on how managers define data quality as opposed to the people who use data in their daily work. One study found scenarios where managers in an organization said they were satisfied with their company's data quality. However, when researchers interviewed individuals who worked with the data daily, they identified quality issues that affected daily productivity and the ability to make business decisions (Wang and Strong, 1996). Wang and Strong (1996) suggest that organizations develop questionnaires soliciting feedback to identify data quality issues that are most pressing among users.

Data derived from integrated databases have multiple points for data input, which can introduce more errors to the database (Ballou and Pazer, 1985; Tayi and Ballou, 1989). However, it can be difficult to determine where data quality is consequential and where it is not; errors in one part of an organization may not be an issue in another section of the organization. (Tayi and Ballou, 1989). A key step in improving data quality is identifying how the errors introduced in one database can result in more errors when interfacing with other databases (Ballou and Pazer, 1985). According to Ballou and Pazer (1985), if resources are limited, as they so often are in government agencies, this might be an area where an organization can focus its data quality improvement efforts. Some organizations develop algorithms that anticipate different error types and the effect they could have on the system, or prioritize the data quality issues most harmful to the entire organization (Ballou and Pazer, 1985). In the case of integrating DDL data with court or law enforcement data, errors from one agency can introduce errors into the database of other branches.

A 2018 Forbes article, "The Data Differentiator: How Improving Data Quality Improves Business," provided a step-by-step guide on pursuing a data quality initiative. First, an organization needs to define objectives so that it is clear why the project is essential and who benefits. This step is crucial for getting support from the entire organization. Then, the stakeholders must identify all the sources of data and the nature of the data quality problem (e.g., standardization problems, duplicate data, missing data). Third, project leaders need to decide on to how to clean data This includes identifying how the data are corrupted and developing a plan of action for improvement. In the final step, the organization must create a standard and routinely test data quality to ensure they meet that standard. If multiple organizations have interacting databases, it is important that all partners commit to improving and maintaining their data quality to ensure quality across the entire system.

DAMA UK, a data management professionals association, created a working paper in 2013 to guide organizations in setting standards and measuring data quality. Like other studies, the DAMA working group emphasized the need for flexibility based on context. DAMA identified six dimensions of data quality that needed to be measured which included: completeness (all data are available), uniqueness (duplicates have been identified and eliminated), timeliness (data are current), validity (data match the database rules), accuracy (data are factually correct), and consistency (information is the same across all databases). According to DAMA, by prioritizing data quality needs based on the context of the data usage, an organization can forefront the data quality dimension to save limited resources and maximize benefits of the data quality initiative. First, an organization needs to identify which datasets are most important for meeting the agency's goals and therefore need to be evaluated for data quality. Second, the project leaders need to determine which data quality dimension(s) are most important for each context.

In many cases, there are multiple relevant dimensions. Then, the organization needs to create a rubric to identify and measure good data quality determine the extent of the problem. Once data quality have been assessed, a plan of action is developed to clean the data. Finally, the organization needs to make this an ongoing regular maintenance task. During this step, the organization must consider how often each dimension of quality should be measured following the initial assessment.

1.6.6 Data Quality and Government Databases
Government agencies frequently integrate databases and technologies to improve public safety and wellbeing. Seifert (2004) discusses the use of data mining following the terrorist attacks on September 11, 2001. U.S. government agencies began to use data mining techniques and predictive analytics to detect patterns in travel, purchases, and behavior that might suggest terrorist activities (Seifert, 2004). The intent was to predict and prevent future attacks by identifying patterns. Other agencies, such as the Justice Department, use the techniques to predict crime patterns. The U.S. Department of Health and Human Services Office of the Inspector General (HHS-OIG) has also used data mining to detect Medicare fraud and waste within government agencies.

Data quality improvement, along with integrating data, data selection, and data mining, are part of a wider process of knowledge discovery that lets organizations develop systems containing searchable data derived from multiple sources of data (Seifert, 2004). This expansive collection of data is made possible by falling data storage costs and the ever-increasing amount of data that are available for search and analysis. Due to the importance of the data being collected and conclusions derived from the data, there are ongoing concerns about data quality. Like businesses, government agencies have to ensure data are correct and complete, eliminate duplicate records, ensure timeliness, and check for errors in data entry (Seifert, 2004).

Government agencies must also consider the difficulty of connecting and interfacing systems housed across multiple government agencies. Agencies must ensure those systems operate on similar standards or processes to provide data to other agencies (Seifert, 2004). Given privacy concerns, agencies must also address concerns about mission creep, where data are used for purposes beyond their original intent and potentially violate personal rights (Seifert, 2004). This is particularly dangerous if there are data quality issues. Data quality issues can lead to misidentification, violating personal rights and wasting time and resources (Seifert, 2004). Not all government agencies or database owners want to participate in data integration. All agencies must agree to the objectives of the data integration. Generally, this is accomplished through memorandums of agreement, which outline what data should be used - the purpose, maintenance, data quality standards, and data retention plans (Seifert, 2004).

1.6.7 Commercial Driver's License Information System

Like the databases discussed in Seifert's article, the Commercial Driver's License Information System (CDLIS) was a network mandated under the CMVSA to protect public safety. CDLIS helped the federal government and states reduce crash rates by monitoring driving records of commercial vehicle drivers with the goal of enforcing licensing standards and testing requirements.

The law which established CDLIS is 49 U.S. Code Chapter 311—Commercial Motor Vehicle Safety. It instructed the Secretary of Transportation to work with states to create an information systems network that accurately identifies motor carriers, commercial vehicle drivers, and license tracking. The network system would also enable data analysis to address and measure the effectiveness of CDL programs enforcement on safety. The law mandated the network be developed so that other information and information systems could be added to CDLIS at the direction of the Secretary of Transportation. In addition, the law made data quality a priority. States were instructed to ensure all data were complete, timely, and accurate across all information systems and initiatives. The Secretary of Transportation was also required to carry out technical and operational oversight to ensure states collect and report uniform, timely, and accurate information, as well as implement uniform federal, state, and local policies and procedures necessary to operate the information system.

CDLIS serves as a clearinghouse and repository for CDL licenses and driver history records. It was developed as a cooperative effort between AAMVA and SDLAs. It is a distributed relational database. CDLIS is maintained and administered by the states. Each state maintains and operates their own segment of the database to administer its state CDL program. The states make all CDL records available to FMCSA and other authorized users. States share data with CDLIS through the AAMVAs CDLIS-Index, which AAMVA operates for the states. The CDLIS-Index acts as a conduit between authorized users to the state CDLIS databases.

Research has found data quality issues with CDLIS. In 2008, the OIG conducted an audit which assessed the system's data integrity. The audit found that that out-of-state convictions were not reported in a timely manner. As a result, states were not disqualifying drivers as required by law due to significant delays in posting convictions to CDLIS records (OIG, 2009). Twenty percent of active CDL holders had convictions that were not posted on their records in the mandated timeframe (OIG, 2009). States lacked the information they needed to ensure only qualified drivers have CDLs. Due to delays in reporting, people with revoked or suspended licenses could have been issued a CDL. A 2018 research project from KTC shows that timely reporting continues to be a problem for states (Keathley-Helil, Martin, and Walton, 2020). Staff members still manually process paper tickets and correct errors in the state licensing and court system database. A staffing shortage also makes it challenging to ensure the 10-day mandate is met.

An additional memorandum from FMCSA at the time listed another problem that presents serious challenges to the CMVSA's mandate: there is no uniform traffic code standard or electronic reporting standard. All 51 jurisdictions have individual systems and codes, and the federal government has limited authority over the technology standards set by states (OIG, 2009). In addition, security issues were identified during the 2008 audit. CDLIS-Access usernames and passwords were transmitted without encryption, leaving the site vulnerable to hackers. The report attributed the security lapses to a lack of state resources and low prioritization by the states. The 2009 report recommends that states develop action plans to improve their out-of-state conviction reporting and establish a timeframe for progress.

The case of Volodymyr Zhukovskyy gives a somber reminder of why CDLIS data quality matters. Zhukovskyy was a CDL holder from Massachusetts. On June 21, 2019, Zhukovskyy was driving a Dodge pickup truck and collided with a group of motorcycle riders in Randolph, New Hampshire. Seven of the motorcyclists were killed, and Zhukovskyy was charged with negligent homicide for all seven deaths. Following the crash, drug testing showed

Zhukovskyy had consumed heroin, fentanyl, and cocaine on the day of the crash. Zhukovskyy also said he frequently consumed drugs before he began his workday as a CMV operator (McCormack, 2020). In May 2019, Connecticut informed Massachusetts' Registry of Motor Vehicles (RMV) that Zhukovskyy had refused to take a breathalyzer in their states, which resulted in a disqualification of his CDL privileges. This conviction and withdrawal were never applied to Zhukovskyy's Massachusetts record and therefore was not reported to CDLIS. Including Connecticut, Zhukovskyy had been charged with DUI, possession of drug paraphernalia, and speeding in six different states (Lutrell, 2019). In the months before the deaths in New Hampshire, Zhukovskyy rolled a car hauler on the highway in Texas, received a citation for an improper lane violation in Iowa, and was arrested with a crack pipe in a Denny's in Ohio (Lutrell, 2019).

Following an investigation, Massachusetts RMV concluded that the agency had failed to post both the electronic and paper notifications from Connecticut about Zhukovskyy. If the withdrawal had been applied to Zhukovskyy's driving record, his CDL would have been revoked. The reasons for not updating Zhukovskyy's CDLIS record are twofold, according to a report released by Grant Thornton LLP in 2019. First, RMV had recently transitioned to a new web-based records database called ATLAS. A programming glitch led to electronic conviction notices being diverted into a queue which required manual processing. While waiting for the vendor to release an update to the programming that would eliminate this problem, no RMV staffer manually processed any of the notifications in the queue, including the one containing Zhukovskyy's withdrawal (Grant and Thornton, 2019). That queue contained 365 other notices about CDLS that were never processed and, therefore, not updated in CDLIS (Lisinski, 2019). Second, another department within RMV was responsible for processing paper notifications, but staff fell behind after experience difficulties with ATLAS (Grant and Thornton, 2019). As a result, the agency decided to prioritize in-state paper notifications over out-of-state notifications to catch up on the workload (Grant and Thornton, 2019). Zhukovskyy's out-of-state notification was among those that were not applied to the driving record. In the process of investigating the backlog of out-of-state paper notifications, the agency found boxes of out-of-state convictions dating back to 2014 that had not been processed (Grant and Thornton, 2019). Once the unprocessed convictions were discovered, RMV reviewed the backlogged out-of-state convictions and began suspending licenses based on those convictions. In the first six months after logging the unprocessed convictions, Massachusetts suspended driving privileges for 2,400 residents (Lisinski, 2019).

When CDLIS records are not updated in a timely fashion, public safety is at risk. It can be difficult for SDLAs to implement and adapt to new software systems, which can endanger data quality. And due to the nature of CDL licensing, a data quality problem in one state can affect the data quality of all 50 states. One might also argue that relying on paper citations and notifications jeopardizes CDLIS data quality since SDLAs may not have the staff to process those citations.

1.7 Conclusions

Before Kentucky agencies can integrate their databases, each agency must address internal data quality issues. Ultimately, each agency needs to define the impact of poor data quality on their operations and on the other agencies they interface with. In the context of the CDL program and the overarching goals of CMVSA to improve highway safety, CDL programs need to identify data quality issues that present the greatest challenges to improving highway safety and cost-effectively prioritize them. Based on recent discussions with Kentucky's SDLA program, three issues affect this mission.

First, there is an ongoing problem with errors in court record transmissions and errors on paper citations from law enforcement. The DDL Court Records branch staff must spend significant amounts of time correcting those errors before they update a driver history record. Staff members would like to explore ways to further automate transmissions from law enforcement and the courts to reduce those errors. One solution could be to implement barcode readers for driver licenses. This approach would reduce the types of data entry errors that court records must address when updating driver history records and automatically record a driver's CDL status. This solution would also help improve the adjudication of CDL cases and create a way to trace a citation from issuance through adjudication and disposition. To this end, the project also looks at the prospects of further automating citations written by local law enforcement.

Second, opportunities exist at Kentucky's CDL program for data quality improvement. Data quality literature focuses on efforts to develop algorithms, clean data, and develop standards. However, in Kentucky's case, improving communication among SDLAs would help improve the accuracy of driving history records. When updating driver history records, staff members need to communicate with other SDLAs if they have questions about the charges on a citation or a driver's license status. Given that each state has unique traffic violation codes and driver history databases,

staff members frequently reach out to other SDLAs. According the DDL staff members, it can be difficult to reach subject-matter experts at other SDLAs. In some cases, they have friendly relationships with SDLAs and can directly contact experts. In many cases, however, they are not able to directly reach a subject-matter expert. Our research team will create a list for Kentucky's CDL program to help staff members contact other SDLAs in a more time-efficient manner.

Finally, staff in Kentucky's CDL program expressed concern over CDL citations issued on federal property, including military bases, national parks, and national forests. Currently, the federal government does not electronically report citations written on federal property. Instead they send paper citations to SDLAs en masse on an unpredictable schedule. This harms the timeliness dimension of CDLIS data quality. This research project will seek to identify laws that require timely citation reporting on federal lands as well as possibilities of automating this process.

Chapter 2 Diversion/Masking

2.1 Introduction

In Kentucky, the Division of Driver Licensing (DDL) is responsible for changing and updating driver history records. The Court Records Section of DDL obtains information from court systems (inside and outside of Kentucky) on adjudicative actions that impact driver license statuses and changes to driver history records. This section handles all communications regarding court adjudications, suspensions, reinstatements, failure to pay a fine, failure to appear in court, and failure to comply with court orders. Agents in this section apply out-of-state convictions, court summons, appeals, expungements, and clearances to driver history records. The agents also investigate and correct circuit court clerk errors on electronic transmissions of court actions. This section also changes the status of standard operator licenses and CDLs.

The CDL Section of DDL handles the bulk of work related to CDLs. All communication concerning CDL driving records, as well as state and federal compliance matters, are routed through the section. Section agents communicate with other SDLAs, FMCSA, and the AAMVA. The CDL Section also interacts with the circuit court clerks during the permit and licensing process. Agents review and post medical certifications, self-certifications, and CDL/CLP applications to driver history records and perform 10-year history surveys.

As documented in a previous KTC study (Keathley-Helil et al. 2020), the Court Records and CDL sections have expressed concerns about masking and CDL-related court cases. When our research team approached them about this research project, they said masking is an issue they would like to see addressed. They identified two main concerns about masking. First, they noted a problem with diversion and masking in Kentucky's court system. Second, they said CDL holders were attending a diversion class offered by county attorneys to keep traffic convictions off of their driver history record, which constitutes masking. Managers of these sections collected data on court dispositions from January 2014 to March 2020 to identify instances of masking. They provided us a spreadsheet with their data. The following sections discuss the data and the subsequent analysis.

2.2 Masking and CDL Penalties

The judicial system plays an important role in maintaining CDL compliance and preventing unsafe drivers from operating CMVs. 41 CFR 383.51 contains penalties for CDL violations (EFCR, 2020). These penalties leave very little sentencing discretion to the judge, which poses problems for judges, prosecutors, and SDLAs. Penalties for CDL violations are severe and vary from 60-day suspensions to lifetime disqualifications. Table 5 lists mandatory penalties for different types of violations.

Table 2.1 Penalties for CDL-Related Convictions

Disqualifying Violation	Penalty
Major Offenses in CMV and Non-CMV • Operating a vehicle under the influence of alcohol as defined by the state in which the violation is committed • Operating a vehicle under the influence of drugs • Not submitting to a form of alcohol testing • Leaving the scene of an accident • Committing a felony in a non-CMV	• Lifetime disqualification
Serious Traffic Violations • Speeding 15 miles or more over posted limits* • Reckless driving* • Improper lane changes* • Tailgating* • Traffic violation connected to fatal traffic crash* • Texting while driving in violation of state or local laws while operating CMV • Using a mobile phone while operating a CMV • Operating CMV without a CDL/CLP or the license their possession • Operating a CMV without the proper endorsements or class as required for the vehicle being operated by the CDL/CLP holder *Pertains to CMV and non-CMV	• Two violations involving CMV in separate incidents in a three-year period: 60-day disqualification • Three violations involving CMV in a three-year period: 120-day disqualification • Two violations in a non-CMV that result in revocation or suspension of driver license: 60-day disqualification • Three violations in a non-CMV that result in revocation or suspension of driver license: 120-day disqualification
Violations Involving Railroad Crossing * *Pertains to CMV and non-CMV	• First conviction: 60 days or more • Two violations in separate incidents in a three-year period: 120 days or more • Three violations: 1 year or more
Violating Out-of-Service Orders • Operating a CMV while under an out-of-service order • Operating a CMV while transporting hazardous materials or vehicle designed to carry 16 or more passengers, and under a vehicle or driver out-of-service order	• First conviction: 180 days to 1 year • Two violations in separate incidents in a three-year period: 2 to 5 years • Three violations: 3 to 5 years

Given the severe penalties mandated by FMCSA, it stands to reason that a CDL holder would seek a case disposition that blocks convictions from appearing on their driving record. In ordinary traffic court proceedings, plea bargains and diversionary practices such as traffic school are standard legal tactics. However, this constitutes masking in the context of CDL regulation and is forbidden in 49 CFR § 384.226 (EFCR, 2020). That regulation states that:

"The State must not mask, defer imposition of judgment, or allow an individual to enter into a diversion program that would prevent a CDL driver's conviction for any violation, in any type of motor vehicle, of a State or local traffic control law (other than parking, vehicle weight, or vehicle defect violations) from appearing on the driver's record, whether the driver was convicted for an offense committed in the State where the driver is licensed in another State."

FMCSA considers a sentence to be masking if the action takes place after a judge convicts a defendant. However, prosecutors can legally amend charges or dismiss them before reaching the hearing phase ("Masking and Other State Court Challenges," 2012). The following is not masking according to FMCSAs definition (Madison, 2012):

• A prosecutor reduces a charge or alters the charge before the case goes to court

- The prosecutor files a motion to dismiss and the court grants the motion
- The case is dismissed due to a lack of evidence or the driver is found not guilty

2.3 County Attorney Traffic School (CATS) and State Traffic School

Kentucky Revised Statute (KRS) 186.574(6) permits each county attorney to establish a traffic safety program for offenders before the adjudication of an offense. These courses are referred to by various names. The Campbell County Attorney's class is referred to as CATS, while Jefferson County's program is called Drive Safe Louisville. DDL staff members refer to them as CATS classes, and that is the term used for this study. When a traffic offender attends CATS, the charge is dismissed or expunged following completion of the course. The case does not go to trial, and the driver does not pay the ticket or court costs. No points are assessed to a participant's driver history record at KYTC.

No standard curricula have been established for CATS classes. Many county attorneys require attendees to view a one-hour online defensive driving video. The Fayette County Attorney's class requires four hours of community service at a local non-profit agency and attendance at a one-hour lecture on traffic safety by a Lexington Fayette County Urban government officer.

Only first-time offenders can attend the CATS diversion program. If the driver wants to attend a CATS class, they submit an application to the county attorney's office, pay a fee, and obtain approval from the county attorney to attend. The county attorney has the right to reject an applicant if they deem the offense to be too serious to warrant diversion. These offenses include DUI-related charges.

During committee hearings about House Bill 480, which sought to codify county attorney traffic classes, representatives debated whether CATS should be considered diversion. The program was referred to as diversionary at multiple points during the hearing. Also, several county attorney websites characterize their traffic schools as diversion programs. As a result of this uncertainty about the diversionary nature of CATS, CDL holders are not eligible for this class, but some nonetheless manage to participate.

Each county attorney has discretion over CATS fees. According to KRS 186.574(6), the fees must be reasonable, and the law limits their use to operating expenses. Prosecutors must report the total fees collected and the number of cases diverted to the Prosecutors Advisory Council by October 1 each year. Each participant must also pay a $25 fee to the court clerk, which is used to hire additional deputy clerks and enhance deputy clerk salaries. We could not obtain statewide statistics on how many drivers attend the course each year, although Figure 1 gives an example of the type of report that county attorneys file each year. In FY 2016, 7,711 drivers attended CATS in Jefferson County (Kentucky's largest county). Students paid $149 to attend the course. The Jefferson County Attorney thus collected $1,148,939 from CATS in FY 2016. The annual report also requires the county attorney to certify the class complies with KRS 186.574(6), which prohibits CDL holders from attending the course.

Based on this information, it is clear that the CATS classes are lucrative for county attorney offices. During hearings for House Bill 480, proponents said the courses provide a revenue stream for understaffed county attorney offices, which have suffered due to multiple budget cuts. Advocates also argued that classes allow prosecutors to reduce the number of non-criminal cases on the court docket.

COUNTY ATTORNEY

TRAFFIC SAFETY PROGRAM REPORT

TO PROSECUTORS ADVISORY COUNCIL

FISCAL YEAR- 2016

(Due October 1 of each year)

COUNTY - <u>Jefferson</u>

Fee charged per offender (Total Cost Less $30 AOC Fee) $ <u>149</u>

Number of offenders diverted into
Traffic Safety Program

a)   **Moving Violations**   <u>7,711</u>

b)   **Equipment Violations**

c)   **License / Registration Violations**

d)   **Total**   <u>7,711</u>

CERTIFICATION

The undersigned does hereby certify that to the best of their knowledge none of the above referenced offenders held a commercial driver's license and that the Traffic Safety Program operated by this County is in compliance with the provisions of KRS 186.574(6)(b) which **PROHIBITS** offenders holding a commercial driver's license from participation in a County Attorney operated Traffic Safety Program.

<u>Signature- County Attorney</u>   <u>10-4-16</u>
                                                                                    Date

Figure 2.1 County Attorney Traffic Safety (CATS) Program Report

Kentucky traffic offenders also have the option to attend state traffic school (STS) classes. KRS 186.574 establishes the right of the state to offer traffic school classes for new drivers and established drivers who have committed traffic infractions. The statute gives courts the right to include traffic school as part of a conviction instead of assessing driving record points; drivers must still pay court costs. When the court refers the driver to traffic school, the court

indicates the referral on the abstract of conviction and sends the referral to DDL. DDL is responsible for scheduling, supervising, operating, and administering the STS classes. Once the court refers a driver to STS, it is considered a court order, and the driver is required to complete the course or potentially have their license privileges suspended. KRS 186.574(2) states CDL holders are eligible for STS. However, judges cannot divert a CDL-related charge or case due to STS course completion. The conviction still appears on their driving record.

The critical distinction between STS and CATS is that a person attending STS has pleaded guilty to the charge and paid the ticket as well as related court costs. In contrast, CATS is technically *pre-adjudication*. STS is also much cheaper than most county attorney classes. STS costs $15 for a four-hour classroom session and $30 for the online course.

2.4 Diversion and CDL Holders in Kentucky
Court Records Section staff members at KYTC began to track masking and diversion for CDL-related cases shortly after the formal implementation of Kentucky's CATS program. At that time, a staff member in the Court Records section of DDL noticed that several cases involving CDL-related charges had been diverted to CATS classes in violation of state law as it would be considered diversion under federal CDL laws. The staff member began running daily reports to identify all diverted or expunged CDL charges, including drivers who attended CATS. The Court Records Section reviews these reports daily.

The first report is the Diversion Report, which includes all traffic court cases diverted on the previous day, and is reviewed by staff members to identify CDL holders. When a staff member identifies a CDL case on the report, they add the charge to the driver's record and update the status if necessary. For out-of-state charges, the staff member prints the requisite court abstract and mails it to the state of record. As a result, the conviction correctly appears on a CDL holder's driver history record and in CDLIS despite the case disposition.

As a second check for potential masking and diversion, the Court Records Section also reviews the CDL/ Commercial Vehicle Daily Activity report. This report contains all failures to appear, recalls, and dispositions. The staff member reviews the report and notes diversions, expungements, and dismissals. In the case of diversions and expungements, a staff member keys convictions to driver history records and updates the license status. If a charge shows as dismissed, the staff member searches for the court case on CourtNet (an online database of all criminal and civil cases filed in the Kentucky court system) to confirm if the dismissal included a refund for the citation and court costs. If the dismissal included a refund, it indicates the charge was dismissed and did not constitute masking under FMCSA regulations. If a dismissal did not result in a refund, the case was diverted and violated CDL regulations. If the staff member finds a diverted conviction, they key it to the driver history record. If a charge was vacated or set aside, they also add it to the record.

Court Records Section staff do not inform the courts when they apply diverted convictions to a CDL holder's driver history record. In some cases, a driver is unaware until they discover the conviction on their driver history record after attempting to renew their CDL or make other changes to their license. When the driver contacts DDL to inquire about the assumed discrepancy, they instruct the driver to contact the court and their attorney.

Court Records Section staff continually reviews these reports because it increases highway safety and to follow the requirements of federal CDL regulations. During an interview with our research team, a staff member said failing to key the proper disposition to a record could lead to a fatal crash. Staff also want to avoid the severe penalties of non-compliance with CDL regulations. Staff members note that judges and court clerk staff may not be informed about federal laws regarding CDLs and masking. In other cases, an attorney may negotiate the dismissal of a charge with a judge or a prosecuting attorney, but does not confirm that a driver is not a CDL holder. DDL has received complaints from county attorneys after discovering an expunged or diverted conviction after a driver has completed CATS. In those instances, a DDL staff member explains masking regulations. DDL staff members say county attorneys usually follow the prohibition against CDL holders attending their class. However, drivers occasionally hide their CDL status when they apply for CATS classes. After one discussion with a county attorney, the attorney added additional checks to ensure that CDL holders were not taking the classes.

2.5 Dispositions of CDL Related Charges and Convictions in Kentucky
After reviewing the daily Diversion and CDL/Commercial Vehicle Activity reports, a staff member adds data to a spreadsheet. The Court Records manager provided the spreadsheet to our research team; it contained all CDL cases

with a disposition of diverted since 2014. Personally identifiable information was removed before DDL provided the data. Each data point included the county of conviction, conviction data, the charge, and disposition. We reviewed the document, noting the counties of convictions. We then defined each of the charges using the abbreviations in the spreadsheet and analyzed the case statistics.

Total Diverted Convictions – 2014 to 2020
We identified 203 diverted convictions from 2014 through March 2020 (Table 6). Eleven cases did not have a date of conviction, and one conviction was for an out-of-state driver. The most diverted convictions recorded was 60, in 2018, followed by 58 in 2017.

Table 2.2 Diverted Cases 2014 – 2020

Year	Number of Diverted Convictions
2014	1
2015	3
2016	8
2017	59
2018	60
2019	42
2020 (Thru March)	19
Unknown Date	11
Total	203

Fifty-five out of 120 Kentucky counties had diverted CDL cases. Out of the 203 diverted cases, nine did not specify the conviction's location. Figure 2 displays counties with diverted CDL cases and the number of diverted cases in each. Counties with diverted cases are shaded in blue, while the counties shaded in white did not have any diverted cases. In most cases, a county had one or two diverted CDL cases. However, some counties stood out in terms of the number of diverted cases, including Fayette (19), Pike (19), Graves (12), Lawrence (11), Oldham (10), Laurel (9), Perry (8), and Clark (7). Due to limited case data, it is not possible to conclude why there were more diverted cases in these counties. One might speculate higher case numbers in Fayette, Lawrence, Oldham, Laurel, and Clark County are due to their being located near interstates, which results in more commercial vehicle traffic. However, that does not explain the case numbers in Pike, Graves, and Perry counties.

Figure 2.2 Kentucky Counties with Diverted CDL Cases

Case Dispositions
We also analyzed data to identify disposition types included in the spreadsheet. Each type of disposition — dispositions as defined by the Administrative Office of the Courts (AOC) (2016) — is explained below. Each category is considered a violation of FMCSA regulations regarding masking and diversion.

- **Diversion**

A diversion program lets offenders avoid conviction if they agree to a rehabilitation program to correct the behavior the resulted in the arrest. In Kentucky, diversion is generally used for first-time offenders (AOC, 2016). A district court can use diversion as a temporary disposition if the charge is dismissed once the offender completes a rehabilitation program. But it can also be used as a final disposition if charges are not to be dismissed. Cases in circuit court can receive a disposition of diverted temporarily when a Class D felony has been diverted.

- **Expungement**

Previous arrests, charges, or convictions should appear on a background check. An expungement completely removes any arrest**,** charge, or conviction from an individual's record (AOC, 2016). In Kentucky, an individual must submit an application for expungement and then file a petition with the court. Expungements are possible for traffic violations, misdemeanors, and Class D felonies (Kaelin and Green, 2016). For a traffic violation or misdemeanor, a person is not eligible for expungement until five years have elapsed. During this period they can have no misdemeanors or felony charges and no current criminal charges pending. Also, individuals accused of sexual offenses against a minor are not eligible (Kaelin and Green, 2016). In the case of a misdemeanor DUI, a person must wait 10 years before they can apply for expungement. However, if they were acquitted or a charge was dismissed, they can apply for expungement after 60 days. Expungement can prevent the following appearing on an individual's record: reckless driving, operating on suspended or revoked license, driving without a license, failure to maintain insurance, and leaving the scene of an accident.

- **Dismissed**

A dismissed case refers to a disposition where an action was put out of court by order of a judge.

- **Dismissed-Diverted**

A disposition of dismissed-diverted indicates the offender completed a pretrial diversion agreement for a Class D felony offense. This disposition is reserved for use in circuit court cases.

- **Pretrial Diversion**

In a pretrial diversion disposition, criminal proceedings are officially suspended against a defendant at any point after a recorded filing. The proceedings are suspended before a judge enters a judgment and the defendant is referred to a rehabilitation program. In the case of traffic violations this generally involves STS or CATS.

- **Dismissal by Motion of Prosecutor**

In this disposition the county or commonwealth attorney has requested that the judge dismiss the offense.

Table 7 lists the number of charges for each disposition type. Overwhelmingly, the most common type of disposition was *diverted*. Data provided by DDL did not specify the terms of diverted cases, so the type of rehabilitation ordered by the judge is unknown. We expected the data to show more instances of CDL cases diverted to CATS. However, a large number of CDL-related cases are typically diverted.

Table 2.3 Disposition of CDL-Related Charges in Kentucky 2007 – 2020

Disposition	Total
Diverted	136
Judicial Diversion	1
Pretrial Diversion	2
Dismissed Diverted	9
CATS Dismissed or Diverted	11
County Attorney Dismissed - no refund	2
Dismissed with or Without Refund	23
Diverted Expunged	4
Expunged	15
Total Dispositions	203

Conviction Details

CDL regulations are in place to ensure only the most qualified drivers operate commercial vehicles on U.S. highways. FMCSA divides CDL violations down into four categories: major, serious, railroad crossing and highway grade, and violating FMCSA out-of-service orders. We were interested in the safety ramifications of diverted, expunged, and dismissed CDL cases. Data were analyzed to determine the severity of offenses diverted in Kentucky based on the offenses contained in the FMCSA categories. Fourteen of the diverted CDL dispositions were cases involving major CDL violations (Table 8).

Table 2.4 Major CDL Offenses Diverted in Kentucky Courts (2014 – 2020)

Conviction	Total
Driving Under the influence	9
Leaving the scene of an accident	1
Driving on a suspended, canceled, revoked, or disqualified license	2
Using a motor vehicle in connection with a felony	2
Total	14

Another 57 diverted CDL dispositions involved serious CDL offenses. For these, depending on the total number of offenses, a driver would have been subject to a 60- to 120-day CDL disqualification. Fifty-seven of the 203 cases in Kentucky were serious offenses, with most being for speeding 15 miles or more over the posted limit (Table 9)

Table 2.5 Serious CDL Offenses Diverted in Kentucky Courts (2014 – 2020)

Serious CDL Offenses	Total
Speeding 15 miles or more over posted limits	45
Reckless driving	7
Texting or Using a Handheld Device	3
Operating CMV without a CDL/CLP or without the license their possession	1
Operating a CMV without the proper endorsements or class as required for the vehicle being operated by the CDL/CLP holder	1
Total	57

FMCSA also mandates a 60-day, 120-day, or 1-year disqualification period for CDL holders committing railroad-highway grade crossing offenses. Eleven diverted CDL case dispositions were related to these types of violations between 2014 and 2020 (Table 10). Three convictions involved a failure to stop at a railroad crossing or disregarding a stop sign, while eight involved a failure to obey traffic control devices at a railroad crossing.

Table 2.6 Railroad-Highway Grade Crossing Offenses Diverted in Kentucky Courts (2014 to 2020)

Conviction	Total
Failure to stop at RR crossing; disregarding stop sign;	3
Failure obey traffic control device, railroad crossing,	8
Total	11

We also examined the diverted CDL convictions that were not major, serious, or railroad-highway grade offenses but would still be included on a CDL holder's driver history record. More importantly, these offenses still constitute a threat to public safety. This group included 121 diverted CDL convictions, with most (54) for going 1 – 15 miles over the speed limit (Table 11). Some of these convictions could be included in the FMCSA's serious convictions category given that going 15 miles per hour or more over the speed limit is a serious violation. However, we did not have access to the details of the convictions. Similarly, it is unknown how many of the other diverted cases would meet those criteria.

Table 2.7 Other Offenses Diverted in Kentucky Courts (2014 – 2020)

Conviction	Total
Eluding, fleeing or evading	2
No liability insurance	24
Speeding 1 to 15 MPH	54
Speeding work zone, school zone	14
Speeding 11 MPH or more over limited access	6
Careless Driving Negligent Driving	9
Improper Driving	3
Improper passing	2
Improper turning	5
Improper lane or location	1
Racing	1
Total	121

2.6 Conclusions

Through daily reviews of conviction and diversion reports, Kentucky's DDL staff members ensure CDL driver history records are updated with information on diverted convictions for CDL-related offenses. From January 2014 through March 2020, staff members thwarted the masking of 203 convictions. Masking convictions place the SDLA in danger of being found non-compliant with federal CDL regulations, potentially leading to the loss of FHWA and MCSAP funds. However, this method of monitoring court dispositions is not ironclad. Masking remains a problem due to prosecutorial and judicial discretion. Research shows that educating county attorneys and judges about CDL laws helps impress upon them the importance of correctly adjudicating CDL-related cases. We also identified a problem with CATS, the county attorney diversionary program — cases exist where CDL holders have completed the program, despite statutory prohibitions. Interviews with DDL staff indicated that county attorneys can ameliorate this problem by implementing processes to ensure that no enrolled students have a CDL.

Chapter 3 Other State Practices

3.1 State Surveys

SDLA compliance is evaluated on the accuracy, completeness, uniqueness, timeliness, consistency, and validity of data provided to CDLIS. Inspections, citations, and court actions are appended to CDL records through state driver license databases. Those data are transferred between enforcement agencies, court systems, and FMCSA. In many cases, these agencies have separate databases. Timely updates of CDLIS records is daunting when agency databases do not interface with each other. One goal of this project is to evaluate the quality of those data and identify opportunities to link data exchange among SDLA administrators, court, and law enforcement agencies using a unique identifier. This data exchange would let agencies track a driver's violation from pre-screening through enforcement, court adjudication, and the CDLIS update. To establish a better understanding of the current situation with CDL data exchange among state agencies, we conducted two surveys. The first survey was sent to state courts, the second to SDLAs.

3.1.1 Case Management Systems and State Courts

The U.S. has a federalist court system, which is complicated, given there are 50 states and varying types of court systems within those states. U.S. courts consist of federal courts and state courts. Federal courts handle matters involving constitutional law, legal disputes among states, military law, and bankruptcy. The Federal court system is divided into a three-part pyramidal system of increasing authority, which includes District Courts, Courts of Appeals, and the Supreme Court (Southeast ADA Center, 2020). The state court system adjudicates cases related to state laws, including criminal offenses, probate, contracts, personal injuries, traffic offenses, and family law (Administrative Office of the U.S. Courts, 2020). CDL cases are adjudicated in the state court system. States have trial courts referred to as circuit and district courts.

Many state courts track cases, dispositions, court calendars, and communicate with partner agencies through a computerized case management system (CMS). Not all states have a unified CMS that is used by all jurisdictions. Some states use multiple in-house software applications, third-party vendors, or both to track court cases across various jurisdictions. However, there are many benefits to a unified court management system. Each court has access to a standardized system that includes centralized system support, maintenance, and upgrades (Lavery, 2016). Courts can share information with all relevant agencies (e.g., law enforcement, motor vehicle agencies) through a centralized database. A CMS standardizes case data such as docket codes, statuses, and disposition codes, allowing courts to track cases more efficiently and exchange data with other courts and partner agencies (Lavery, 2016). A CMS uses unique identifiers (e.g., date of birth, social security number, address) to connect parties to cases while preventing duplicate entries (Lavery, 2016). Unified CMS improves data quality as clerks need fewer steps to enter data than paper filings or multiple case management systems (Loewer, 2015).

Many courts rely on outdated legacy systems that make it difficult to upgrade or implement a new CMS (Loewer, 2015; IBM, 2008). State courts also face budget and resource constraints despite an increased number of court cases (Loewer, 2015; IBM, 2008). States must identify the most cost-effective means for meeting their needs. A crucial decision for courts development is whether to buy an off-the-shelf product or have the product created in-house. There are benefits to both approaches. In-house development lets an agency customize the software to meet its needs; in the case of court systems, these needs can be quite expansive. In-house developers are also more familiar with the agency's culture, readily available for in-person meetings, and likely to be invested in the success of the project (Cleveroad, 2020). However, in-house software development is more expensive as the agency is responsible for overhead, taxes, salaries, and benefits (Cleveroad, 2020). It may be more difficult for government agencies to hire qualified talent because they may not pay salaries competitive enough to recruit and maintain talented employees (Cleveroad, 2020). States may also find that systems developed in-house are too expensive to maintain and make necessary system upgrades to take advantage of technological advancements (Thomson Reuters, 2020).

The inherent challenges of developing a software program in-house often lead state agencies to choose a third-party developer. A third-party developer can help a state agency create a more sustainable CMS. A third-party off-the-shelf product might be even more cost-effective. An article from Thomson Reuters (2020), the company that developed the C-Track product, criticized third-party vendors that develop customizable software. According to Thompson Reuters (2020), vendors create customized products that have to be continuously tweaked to meet the court's needs. Customized projects require an extensive coding process, testing, troubleshooting, and retesting, which can be

expensive and inefficient (Reuters, 2020). When states invest in off-the-shelf platforms, the product is already developed, and minor programming changes can be done to fit an application to the agency's needs. As technology changes and the court needs change, these programs evolve so that courts can take advantage of maintenance and upgrades included when they purchase products licenses.

3.2 State Court Survey Results

We wanted to gather information on the types of software applications courts in different states are using as well as their vendors. The research team contacted 28 states by email, asking each state court agency to provide information about the software application used by their court system as well as vendors. Eighteen states provided open-ended responses by email (Figure 3).
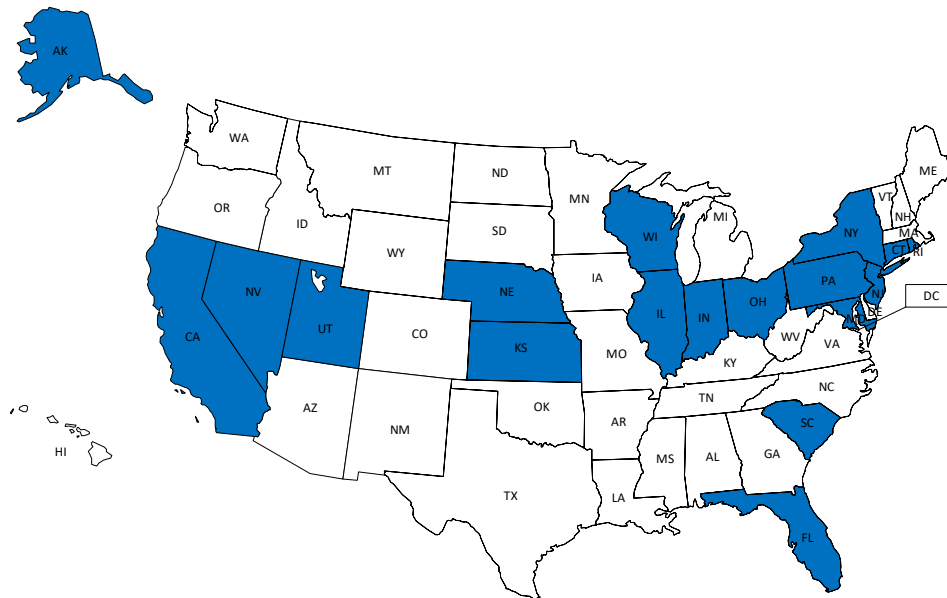

Figure 3.1 State Courts Which Responded to Survey

Six states use court management systems (CMSs) developed in-house by the agency. Seven states use a CMS developed by a third-party vendor, and five states use a combination of in-house and third-party CMS. Some respondents also discussed the interfaces between the CSMs and the SDLA.

According to the respondent from Pennsylvania, the Administrative Office of Pennsylvania Courts has an Information Technology department that developed and maintains proprietary statewide CMSs for the Magisterial District Courts, which decide cases related to traffic citations, and the Courts of Common Pleas, which decide major civil and criminal cases. These systems provide data via a secure file transfer protocol (FTP) server to the Pennsylvania Department of Transportation (DOT). These data include driver license suspensions and statutory convictions. Files are transmitted daily and processed by the Pennsylvania DOT.

Wisconsin's CMS was developed in-house. The system includes an interface with Wisconsin DOT. Citation data for standard license holders and CDL licenses holders are imported directly into the CMS from the filing agency. Data are passed to SDLA as a data file.

All Utah court conviction data are entered for a given day are sent in a nightly batch file to update Utah criminal history records and Utah driver history records. The Utah driver license division software creates tasks for users for specific convictions for CDL drivers and CDL license holders that need to be sent electronically. Users manually submit the AAMVA transaction using the Utah Driver License System, an application developed in-house by state employees.

Nebraska and Florida's systems are custom-built case management systems, and both states maintain the CMSs without the assistance of third-party vendors. New Jersey also has a statewide court system that does not use third-

party vendors. New Jersey's case management applications are written in-house in COBOL and JAVA. New Jersey's court case management system has existing interfaces with DMV and law enforcement agencies.

3.2.1 States That Use Software Developed by a Third-Party Commercial Vendor

Maryland uses software from Tyler Technologies for the following: Odyssey court case and workflow management, electronic filing and service management, financial management, and managing access to electronic case records.

Some states that use third-party vendors are in the process of updating their CMSs. In California, court case data are generated and managed by individual trial and appellate courts, which are independent contracting entities. Each court is operated separately, and courts generally contract with commercial vendors for various CMS products and services based on its business needs. Some courts have developed proprietary CMS solutions. All CMSs used in California trial courts must provide interfaces that enable communication and data sharing with other government entities. According to the Judicial Council of California, in 2017 California issued a Request for Proposals (RFP) to identify suitable vendors for multiple leveraged procurement agreements (Master Agreements) for licensing and the implementation of new CMSs. These vendors are to replace existing legacy systems in the California trial courts. The council issued Intents to Award master agreements to the following case management system vendors: Tyler Technologies, Journal Technologies, Inc., Justice Systems, Inc., and Thomson Reuters. All currently provide CMSs to California courts.

The Alaska Court System uses CourtView to manage court case data. Equivant is the software vendor for the CourtView application. The contract includes maintenance and support, which is renewed each year. Nevada has a non-unified judiciary. Each court maintains its own CMS and controls its case-level information. Some courts have deployed CourtView. CDL violations and dispositions data are maintained by the Nevada Department of Public Safety (DPS) and DMV. DPS recently selected Brazos Technology to modernize the Nevada Citation and Accident Tracking System. The DMC uses CourtView. Some Nevada courts use an electronic information-sharing platform called the Multi-County Integrated Justice Information System (MCIJIS). MCIJIS facilitates electronic data exchanges between justice agencies. These data include DMV convictions, failure to appear, criminal dispositions, and warrants. Nevada courts have established contracts with the following developers: Odyssey, Journal Technologies, Tyler Industries, Pioneer Technology Group, Tybera, Casselle, and UCS.

Ohio is a *Home Rule* state, so each court operates its CMS and is responsible for transmitting information to the Ohio BMV regarding traffic violations. Courts rely on third-party vendors for their CMS. Additionally, there are over 300 mayor's courts that also hear traffic cases and are responsible for submitting information on traffic violations to the BMV. Some courts may use their CMS to interface with the Ohio BMV. Since all of this is done at the local level (roughly 164 municipal and county courts and over 300 mayor's courts), it is hard to obtain information on the vendor or software used by each court.

Indiana traffic courts use two principal CMSs. The first is Odyssey, which has been implemented by 75 percent of state courts. The second, Computing System Innovations (CSI), is deployed in the remaining 25 percent. CSI software is provided to Tyler Solution Partners customers through a partnership between the two companies. Court data from Odyssey and CSI, are exchanged with Indiana BMV through INcite (Indiana Court Information Technology Extranet), an interface developed in-house by Court Technology. Courts that do not use Odyssey or CSI submit case information to BMV in paper form.

In Illinois, the Administrative Office of the Illinois Courts (AOIC) works closely with circuit clerks and the Illinois Secretary of State's (SOS) Office for disposition reporting requirements. The AOIC manages the Automated Disposition Reporting (ADR) Program, which facilitates electronic disposition reporting to several agencies, including the Secretary of State. Statutes require clerks to report dispositions to the SOS within five days under Illinois law. Courts in Illinois use vendor-supplied CMSs, although they do not use the same vendors.

3.2.2 States That Use a Combination of In House and Third-Party Developers

States can also use a combination of court management software developed in-house and by third-party vendors. The New York State Unified Court System has four primary CMSs used in the adjudication of traffic offenses. The Advanced Database Master (ADBM) system is a third-party vendor product. ADBM is currently used in the upstate New York supreme and county criminal courts, excluding Erie County. The remaining systems were developed and are maintained in-house by the Unified Court System staff. CRIMS, which provides information on criminal cases

with future appearance dates for certain New York State criminal courts, is used in the New York State Supreme and County criminal courts in and north of New York City as well as in Erie County. The CourtRoom Program (CRP) is used in Town and Village justice courts. New York, like California, is implementing changes to its CMSs. The Universal Case Management System (UCMS) is used in city and district criminal courts, but will also replace ADBM and CRIMS at Supreme and County criminal courts.

In South Carolina, all Magistrate Courts and approximately 33 percent of Municipal Courts use the statewide CMS. The South Carolina Judicial Branch developed this system in-house. The CMSs interfaces with the DMV. The majority of the other Municipal Courts use LawTrac, legal software developed by Mitratech.

The Information Technology Division of Connecticut manages the development and maintenance of in-house and third-party software. Law enforcement and the courts interface via a web service. As a whole, the court system uses a combination of new technology, consisting of web applications and relational databases, with old technology in the form of a mainframe COBOL system. Connecticut uses Attunity, a middleware product, to integrate new and old technologies.

The vast majority of courts in the Kansas judicial branch use FullCourt, a JSI product. However, one district developed its in-house system. Over the next two years, Kansas will implement the Odyssey CMS.

Rhode Island state courts use Tyler Technologies' Odyssey for court case data tracking. The state also uses custom in-house software to transmit the records to the DMV each day.

3.3 SDLA Survey Responses
We also wanted to gather information about the systems and vendors used by SDLAs. An email survey similar to the email sent to state courts was sent to SDLAs to assess CDL-related data quality exchange with other agencies. Five states responded to the survey (Figure 4).
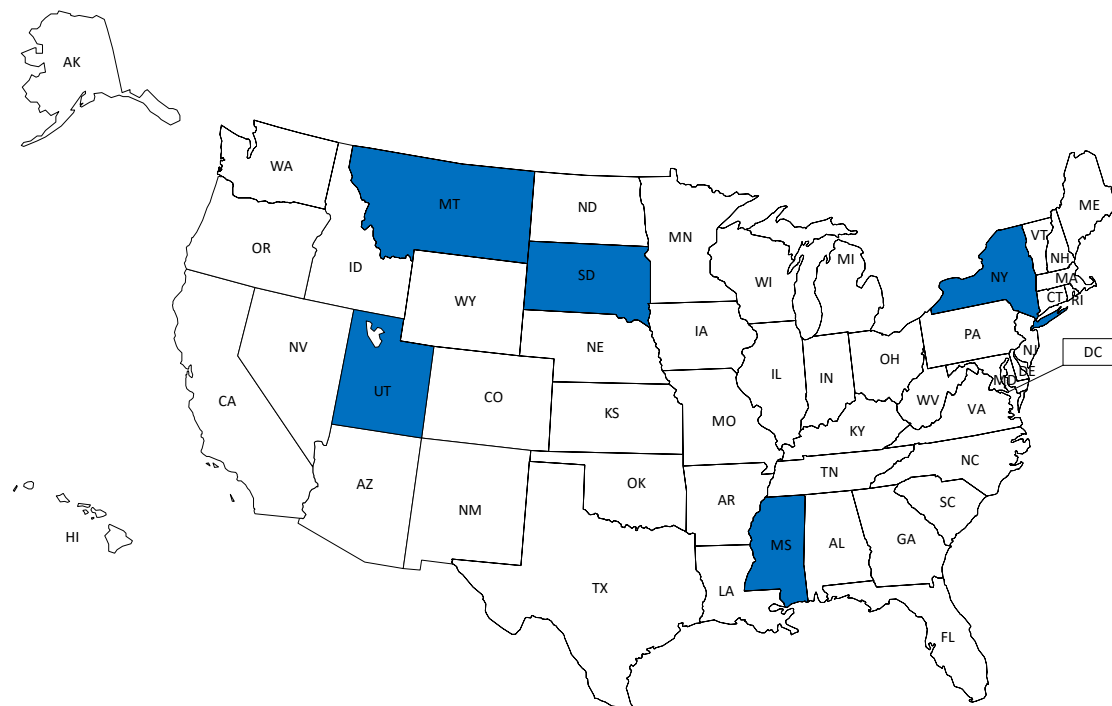

Figure 3.2 State DMVs That Responded to Survey

3.3.1 In-House Development and Maintenance

The Utah courts use an in-house system program written by Utah's AOC called CORIS (Court Information System) to enter case information. Each day all court conviction data are entered and sent in a nightly batch to Utah Criminal History and the Utah Driver License record, where the conviction is automatically added to the individual's driving record. The Utah Driver License Division software then automatically directs certain convictions to agents, which are sent electronically for CDL drivers and CDL License holders. Agents manually submit the AAMVA transaction using the Utah Driver License System (developed in-house).

New York has 20 million licensed drivers and maintains 35 million driving-related records. The New York State Department of Motor Vehicles handles much of this processing in-house. Agency developers write custom applications to process tickets and handle the interface with CDLIS. The motor vehicle system software processes driver histories, sends updates to driver history records, and performs automated checks against CDLIS before driving credentials are issued.

South Dakota also uses software that was developed in-house. The South Dakota Bureau of Information and Telecommunications (BTI) built the South Dakota Driver Licensing Program to maintain driving records.
Montana's in-house system manages driver history records. The state also uses an in-house system that receives conviction data from courts and transfers these data to the driver history application.

3.3.2 Third-Party Vendors

Only one SDLA respondent uses software from a third-party vendor. The State of Mississippi manages driver history records for CDL and regular licenses through the third-party vendor, Idemia. Idemia created the D360 software application for all issuance and driver record management. The state maintains a contract with Idemia for this service.

3.3.3 Conclusions — SDLAs

The vast array of CMSs and interfaces with SDLAs highlight the complexity of how court data are gathered and transmitted throughout the U.S. The lack of standardization and centralization leaves many opportunities for lapses in data quality for CDL-related cases. State courts are evenly split in terms of whether they use CMS developed in-house, by a third-party vendor, or both. Although the responses for the SDLA survey were very limited, it appears that SDLAs are more likely to use software developed in-house.

3.4 Vendor Survey

Our team also wanted to learn more about the experiences and perspectives of software developers that work with state courts and law enforcement agencies. We developed a survey using the Qualtrics survey tool for technology vending companies identified as having contracts with state and/or federal courts systems. Each vendor had previously been contracted by state or federal agencies to aid with court data collection and management. Specifically, we were interested in any database management or database integration activities that may have implications for CDL data quality. For example, Tyler Technologies' Odyssey's Court Solutions are web-based software applications that provide data integration between law enforcement and court systems. Services offered include case management, electronic filing of documents, and custom interface design (Tyler Technologies, 2020). Brazos, another Tyler Technologies product, is an e-citation software application that enables automatic processing and data integration with court and public safety systems (Tyler Technologies, 2020). Journal Technologies' eCourt offers similar solutions through data management and electronic filing capabilities (Journal Technologies, 2020).

3.4.1 Purpose of Survey and Survey Questions

The purpose of the survey was to gain a deeper understanding of the current capabilities and strategies used by tech vendors to improve intra- and interagency CDL data quality. Questions included in the survey were approved by all members of our research team. The survey was intended to be completed by individuals having extensive knowledge of the product as well as insights about the procedural activities involving implementation, training, and support/ maintenance (i.e. software developers, project managers, software engineers). Survey questions are listed below.

1. Does your company develop any of the following software applications? (Check all that apply.)
   o Court case management software
   o Electronic citation software
   o Driver licensing/driver history record databases
   o Other (Please specify)

2. What court systems utilize your case management software? (Check all that apply.)
    o   Local/district/circuit courts
    o   State appellate and supreme courts
    o   Federal courts
    o   Courts of special jurisdiction (i.e. traffic court, family court)
3. Is your case management system a standalone system or do you customize it to interface with
other state systems and applications?
    o   Standalone system
    o   Interfaces with other state systems and applications
4. Which other state software applications interface with your case management software? (Check all that
    apply.)
    o   E-citation software
    o   State crash database
    o   GIS/mapping software
    o   Injury surveillance software
    o   Driver licensing/driver history records database
    o   Other (Please specify)
5. Does your case management software application include a field that indicates whether someone cited for a
    traffic violation has a commercial drivers' license (CDL)?
    o   Yes
    o   No
6. What sort of training do you provide users of your case management software?
    o   Initial training and implementation
    o   Initial training, implementation, and technical support as needed
    o   Routine training and technical support as needed
    o   Other (Please specify)
7. What stakeholders were included as you developed your case management software?
    o   State court administrators
    o   Jails/corrections
    o   State transportation department
    o   Local court officials
    o   County/local prosecutors and attorneys
    o   State/local software developers/analysts
    o   Other (Please specify)
8. Is it possible (yes or no) for your software users to run a report that produces aggregate court-level, county-
    level or state-level statistics about traffic citations and dispositions for CDL holders while filtering out
    citations and dispositions for standard licenses?
    o   Court-level statistics
    o   County-level statistics
    o   State-level statistics
9. Do you have processes (yes, no, or unsure) that address each of the following data quality issues?
    o   Completeness
    o   Uniqueness
    o   Timeliness
    o   Validity
    o   Accuracy
    o   Consistency
10. Are there any manual or automatic processes that allow users of your court case management software
    application to check for data quality issues? Please describe.
11. What are some of the barriers you have experienced respecting data integration with your software and other
    existing data information systems? Please describe.
12. Do you have a recommendation for state and local courts that would improve their data quality challenges or
    enhance their statistical reporting capabilities? Please elaborate.
13. What is your official job title within your organization?
14. What is the name of the case management software application you offer?

We identified potential respondents using company websites and LinkedIn. LinkedIn was chosen because of its popularity and wide use across all industries. It also is a platform that offers many features such as networking, recruiting, and employment acquisition. On June 2, 2020, 18 professionals were sent an introductory message via email or LinkedIn InMessage explaining the purpose of the survey and why they were chosen to complete it. Despite our efforts, we did not receive any responses. It is possible the ongoing pandemic factored into this result.

3.4.2 Conclusions — Vendor Survey
Despite getting no responses, in the future a vendor survey should be considered when assessing CDL data quality issues within and between state agencies. The questions address multiple aspects of implementation and can provide an overview of current strategies used at state agencies across the nation. Tech professionals can provide valuable insights about program-specific methods for improving data quality, and their input is warranted when developing best practices.

Chapter 4 CDL Indicators and E-Citation Graphics

4.1 Importance of Access to CDL-Only Cases
Having access to CDL-only data is imperative for understanding driver and crash trends and evaluating adjudication processes in the U.S. Furthermore, access to CDL-specific citation and court case data lets states determine where revenue may be lost and whether additional enforcement efforts are required to increase compliance with highway safety laws or reduce crashes. For any improvements to be made in the adjudication process there must be access to meaningful, reliable data. Unfortunately, available CDL data varies greatly from state to state, creating major gaps and inconsistencies.

4.2 Kentucky E-citations (KYOPS)
The primary mechanisms states use to collect CDL enforcement data are the interfaces in the KSP's E-Citation software. Figure 3 depicts one of the prompts that Kentucky officers see when making a traffic stop or responding to a crash (Kentucky State Police, 2011).

Figure 4.1 Preliminary Questions in KYOPS

The circled area shows where officers must check *Yes* or *No* when prompted with *Commercial Vehicle* check box. This forced-response item requires that each officer check whether the individual receiving a citation was operating a commercial vehicle. Each data point is stored in a database and can be extracted for bulk reports and statistical analysis.

Figure 4 depicts another screen from KYOPS officers must complete when issuing a citation. Nearly all of the information entered into KY-OPS is done so with dropdown box choices to eliminate error (Truesdell, 2020). The circled dropdown box indicates where the issuing officer chooses the type of identification the driver presented. This is where officers can select the license type, including a CDL where appropriate. Collectively, the CMV indicator and *I.D. Type* let officers track whether any enforcement activity pertains to operation of a commercial vehicle or an individual who holds a CDL.

Figure 4.2 Offender/Violator Screen in KYOPS

4.3 Updates for Utah, Minnesota, & Michigan

We sent the following questions to Utah, Minnesota, and Michigan to determine if any updates have been made to their citation process to distinguish between standard license holders and CDL holders. Michigan and Minnesota began to incorporate these changes in 2017. Utah, on the other hand, already had the CDL indicator as of 2017, but its use was optional and therefore did not produce consistent results. Each of the state court systems were contacted again in June and July 2020 in an effort to determine which measures have been taken to date.

1. Have you implemented changes to your electronic citation software that allows you to track enforcement and adjudication outcomes for CDL holders separate from standard operators' licensees?
2. Is there a separate way to indicate if an individual cited for a traffic offense is driving a commercial vehicle (CMV)? (In some cases smaller CMVs can be driven without a commercial license.)
3. If you have implemented either, when was it implemented? When did the tracking of CDL holders and/or CMVs as an indicator take effect?
4. Are law enforcement officers required to fill out the field on a citation or is it an optional field?
5. Does the state have any data available yet pertaining to citations and adjudication dispositions related to CDL holders?

Neither Michigan nor Minnesota have implemented changes that will produce CDL-only data reporting capabilities during the adjudication process (Question 1). Although additional efforts were made to contact the court systems in Michigan to address Questions 2-5, no further communication occurred. Information from the Minnesota Court Services Division revealed that Minnesota implemented an indicator for individuals driving CMVs and was implemented in 2009 with the current CMS. However, law enforcement officers are not required to check if the driver is in a CMV and remains optional. Because the indicator is optional, Minnesota does not have any data available on CDL holders (Bendewald, 2020). Utah, however, provided some preliminary data about CDL holders (Table 12).

Table 4.1 Total Cases/Charges Involving a CDL FY 2015-June 2020 in Utah

Year	Total Cases Involving a CDL FY 2015-June 2020 in Utah	Total Number of Charges Involving a CDL FY 2015-June 2020 in Utah
2015	38,249	97,202
2016	26,828	72,380
2017	27,709	80,023
2018	28,011	81,126
2019	26,220	76,099
2020	29,964	71,509
Grand Total	176,981	478,339

This table contains the number of cases involving a CDL holder in Utah for fiscal years 2015-2020. The second column lists the number of cases involving a CDL holder. The third column provides the total number of charges involving a CDL. Although there are current data, it is potentially unreliable due to inconsistent reporting by Utah officers.

4.4 Inconsistencies in CDL-only Data Collection
While Table 12 presents data related to CDL-only cases in Utah, efforts to contact the Utah Department of Public Safety to inquire about the reliability of the data went unanswered. Previous correspondence with state court representatives revealed that while the CDL indicator had been implemented years prior, officers were not presented with a forced choice. Because officers do not have to make a selection, data related to the indicator are likely missing. The data suggest a significant number of officers check the indicator, but it is difficult to know the collective response rate for the CDL indicator selection.

Inconsistencies seen in Utah, Michigan, and Minnesota with collecting CDL data are prevalent across the U.S. and create large gaps in national CDL datasets. States like Michigan and Minnesota have not yet incorporated CDL indicators, and therefore cannot gather any CDL data. The E-Citation software used to issue citations in Kentucky, however, forces each issuing officer to choose whether an individual possesses a CDL and whether the individual involved in the stop or crash was in a CMV. These distinctions let researchers pull CDL-specific data and derive meaningful inferences with the use of e-citation software.

Chapter 5 Data Quality

5.1 Data Integration Strategies

One challenge many states face with respect to managing CDL data quality is a lack of data integration. According to IBM, data integration is "the combination of technical and business processes used to combine data from disparate sources into meaningful and valuable information" (IBM, 2020). Data integration provides many benefits, including improved data quality, data enrichment, and real-time data delivery (Alley, 2020). Many sectors like the economic and industrial sectors rely on data integration strategies for decision-making processes to improve service, view trends, and make more accurate predictions based on collected data. However, other sectors including public health, public policy, and transportation have successfully used data integration to improve data quality.

5.2 Successful Data Integration Strategies

5.2.1 Zimbabwe – Prevention of Mother to Child Transmission of HIV

In all business sectors there are many examples of successful data integration strategies that lead to more informed practices and outcomes. One example comes from a public health intervention conducted in Zimbabwe. Sibanda et al. (2020) reported on the process of data integration methods by the Ministry of Health and Child Care (MOHCC), National AIDS Council, and the Organization for Public Health Interventions and Development (OPHID) to improve the countrywide prevention of mother-to-child HIV transmission (PMTCT). While these entities had been collecting and sharing data upon request, there was no evaluation mechanism in place that incorporated data from all sources simultaneously. Due to these circumstances, the fidelity of the program was not maintained which resulted in breakdowns in services provided and missed opportunities to decrease the likelihood of mother-to-child HIV transmission. Despite the implementation of the program and other initiatives, transmission rates remained high.

Data included in the data integration process came from four sources: research, the Ministry of Health and Child Care (MOHCC), the Families and Communities for Elimination (FACE HIV) Program, and modelling software. Data were collected as part of a study conducted in randomly selected health centers within five of Zimbabwe's 10 provinces. Survey participants included mothers who were 16 years of age or older and their 9-18-month-old infants. Study participants were interviewed and provided a blood sample that was tested for HIV. The MOHCC routinely collects data provided by the prevention program at 1,560 different facilities across Zimbabwe. Paper-based data are aggregated into catalogs that track mothers and their children before, during, and after birth. In 36 districts, pilot program administrators collected data and entered it into a national database. Health facilities with higher volumes of patients entered previously aggregated data into an electronic monitoring system. The FACE HIV Program was implemented in 660 facilities by the Organization for Public Health Interventions and Development (OPHID) through emergency funding. The FACE HIV Program collected much of the same data as the MOHCC, but with more regularity and scrutiny. Results from modeling software, Spectrum, were then assessed. Spectrum is modeling software approved by the United Nations Program on HIV/AIDS (UNAIDS) to create realistic estimates of how diseases impact various populations (Avenir Health, 2020). Based on data inputs, Spectrum can produce models of current trends and major indicators of disease spread.

Researchers worked to improve program outcomes by identifying pertinent data from each source, creating a system to integrate data, finding gaps in data, and identifying ways to improve the prevention program based on findings. With thorough integration methods, researchers determined where and how breakdowns in the program were happening, either with distribution of services or tracking of relevant data. Based on the work done by the research team, subsequent interventions were carried out to correct the inconsistencies and improve program practices and outcomes. Data integration was a necessary first step for developing an accurate representation of the situation.

The research team provided data that allowed subsequent interventions for improving program processes through data integration. However, data quality issues created obstacles for completing data integration from all four sources. Incomplete data were not uncommon, and indicators were measured inconsistently across datasets. Furthermore, much of the available data were handwritten, which can lead to misinterpretations. Last, the electronic data researchers used had been previously input by workers at healthcare facilities. Despite these challenges, the process of data integration provided a comprehensive way to access and use data, which improved outcomes and prevented more Zimbabwean mothers and children from contracting HIV.

This case study demonstrates the importance of data integration and highlights how it is a comprehensive way to improve data quality. Researchers in Zimbabwe improved data completeness, accuracy, consistency, and timeliness after combining data from multiple sources. Incomplete or missing data became more complete by cross-referencing multiple datasets. More complete data better reflected how many mothers and children were being served, the services they received, and in what geographical locations. Data consistency was greatly improved through data integration. By combining all four sources of data, standardized indicators were created and overlapping information was identified and appropriately classified. The new dataset is more reflective of the current HIV transmission rates, services being rendered, and the areas of greatest need. Improving data quality through data integration let researchers create conditions that would allow future initiatives to better serve those at greatest risk.

5.2.2 Rhode Island — *RI 360*

Researchers in Rhode Island created *RI 360*, a comprehensive anonymized database containing data from separate agency databases. The project specified guidelines for when additional care and services for low birthweight babies and their mothers were warranted (Hastings, Howison, Lawless, Ucles, & White, 2019). Agencies with databases containing relevant health, education, and economic records were integrated into *RI 360*. Table 13 lists state agencies and the information collected.

Table 5.1 State Agencies and Sourced Data

State Agency	Data Sourced
Department of Health	30 years of birth records
Department of Education	Test scores from 3rd, 5th, and 8th grade standardized tests, PSAT, SAT, and Advanced Placement exams, records of grade repetition, Individualized Education Programs, disciplinary action, college enrollment (National Student Clearinghouse)
Department of Human Services	Enrollment and payment records for Supplemental Nutrition Assistance Program, Supplemental Security Program, Medicaid, and Temporary Assistance for Needy Families
Department of Labor and Training	Quarterly wage records measuring maternal employment rates and earnings following birth
The Centers for Disease Control and Prevention	Survey responses from Pregnancy Risk Assessment Monitoring System measuring maternal attitudes and experiences after giving birth

Data integrated into *RI 360* were originally collected by the respective agencies. Multiple steps were taken to lessen the risk of compromising data during integration phases and protect sensitive information collected from participants when applying for and receiving additional care and/or services. Data integration process began by using a physical data enclave. A data enclave is "a secure network through which confidential data, such as identifiable information from census data, can be stored and disseminated" (National Institutes of Health, 2020). A physical data enclave provides higher levels of security by only letting protected data be accessed in a monitored area where they are stored. Key features of the enclave are listed in Table 14.

Table 5.2 Key Features of Physical Enclave

- Physically secure
- Isolated from the internet
- Data transfers are controlled and must be approved
- All access to the database is audited
- Limited number of individuals have access to database

Source: Hastings et al. (2019)

After measures were taken to protect the data, researchers created an identifier so individuals could be tracked across all datasets while preserving their anonymity. Hastings et al. (2019) assigned a global identifier to each record after sensitive information was removed. Matching records were found across databases via social security numbers, dates

of birth, and the use of Soundex algorithm, a system that indexes last names by sound instead of spelling for easier identification (Zelenski, 2020).

Data integration let stakeholders understand the developmental, educational, and economic outcomes of children who were provided additional care and services versus those who were not based on a predetermined weight threshold for low birthweight babies. Aggregate data showed that babies born just below the weight cutoff to receive additional care and/or services thrived more in later life than babies just above the threshold. Higher standardized test scores, increased college enrollment, and decreased dependence on social programs for additional resources (decrease of $27,291 by age 10; decrease of $66,997 by age 14) were all found to be benefits of receiving additional care and services at the time of birth, which averaged $4,000 (Hastings, Howison, Lawless, Ucles, & White, 2019).

Based on the analysis of the integrated data sources, researchers provided policymakers and other stakeholders detailed information on outcomes which demonstrated current standards and practices were not as sound as they were perceived. Before integrating administrative data from several state agencies, policymakers were forced to make decisions based on incomplete data, resulting in the perpetuation of misguided policies that ultimately cost Rhode Island valuable dollars. The new system will allow future decisions to be made with much more accurate representations of the health, economic, and educational effects of public policies.

Despite the great successes Hastings et al. (2019) achieved through data integration, there were obstacles. Rhode Island did not have a universal coding mechanism across all state agencies and much of the data varied in form by agency. These constraints warranted the development and use of a tool called Secure Infrastructure for Research with Administrative Data meant to aid in the normalization of data across all sources.

5.2.3 Wyoming — Connected Vehicle Pilot Deployment Program

In 2016, the U.S. Department of Transportation (USDOT) awarded more than $45 million to New York City, New York, Tampa, Florida, and the state of Wyoming. Wyoming used the funds to establish the Connected Vehicle Pilot Deployment Program, which allows for the shared use of electronic messages created and distributed through connected vehicle (CV) applications. The purpose of these applications is to "save lives, improve personal mobility, enhance economic productivity, reduce environmental impacts, and transform public agency operations." The pilot program is currently ongoing (Fok, Garcia, & Hartman, 2019; United States Department of Transportation, 2020). Wyoming's pilot program aims to provide CMV drivers with up-to-date information from the traffic management center (TMC) and other commercial vehicle operators. To create data that is useful to Wyoming's TMC, data collected from the CVs were integrated into the system already in use. Figure 5 displays the sources of information for TMC.
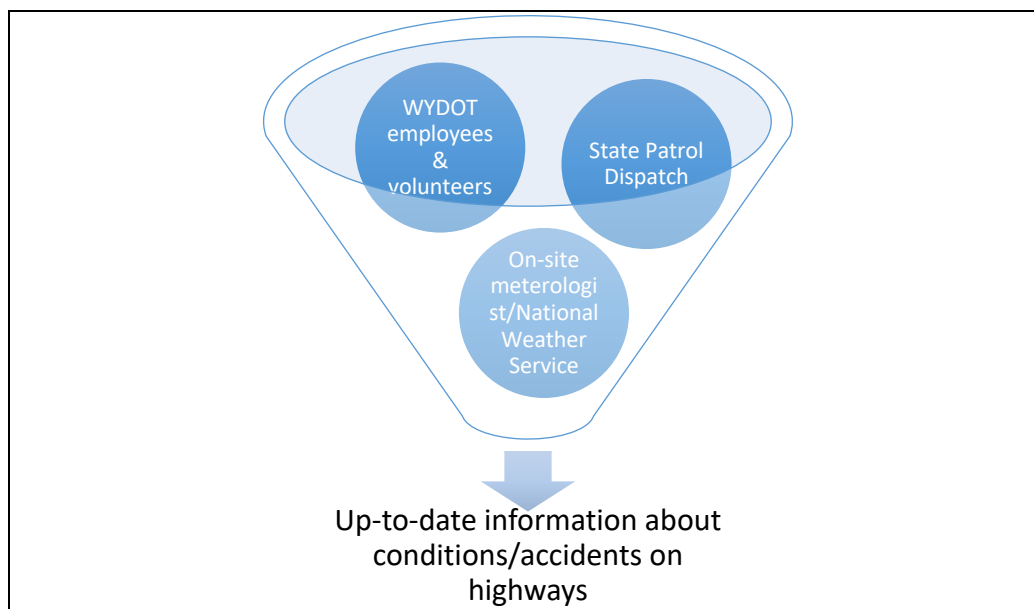

Figure 5.1 Sources of Information for Wyoming Traffic Management Center (TMC)

Each independent source of information is necessary for the TMC to have up-to-date information and provide consistent messaging to Wyoming drivers. By having multiple sources of time-sensitive information funneled to the TMC data hub, the TMC could more accurately determine the appropriate actions for road crews and provide details to the public on expected roadway conditions. Incorporating information from CVs increases data quality. Two key programs that are exchanging information with the CVs are the 511 system and the Commercial Vehicle Operator Portal. Drivers can call 511 or download the application to their phone or other compatible device to receive or report road condition information. Likewise, the Commercial Vehicle Operator Portal provides information about routes frequently traveled by CMVs.

Wyoming's implementation plans included outfitting vehicles (400) with data collection units and placing approximately 75 standalone roadside units (RSU) along I-80. According to the USDOT, at least 150 of the vehicles were heavy trucks and regular users of I-80. In addition, 100 of WYDOT's vehicles were outfitted with onboard units (OBUs) and weather sensors, including fleet vehicles, snow plows, and highway patrol cars (United States Department of Transportation, 2020). Although the pilot project ended in April, 2020, roadside units and WYDOT vehicles equipped with CV capabilities continue to collect data. Benefits of the pilot project include improvement of current practices, identification of areas for further development, and identification of existing holes in data or services.

Because the pilot project was such a large undertaking, many challenges emerged. One of the immediate challenges was integrating the information from CVs into WYDOT's existing traffic management system and daily procedures. Tight budgets prevented the agency from hiring additional staff, which meant that the data load would need to be managed by the existing staff members should technical difficulties occur. Furthermore, the data generated from the CVs were not meaningful to the TMC and had to be integrated into the system without requiring a total restructure of TMC. Last, the safety and security of data collected and shared by CVs raised concerns about the security of sensitive information. WYDOT has not yet resolved all of the concerns, but the early stages of development have provided many advances in working practices and created a framework that other states can emulate. The necessity of data integration is reflected in the implementation of the CV pilot program by the WYDOT and serves as an example for how data quality can aid different stakeholders.

5.2.4 Lessons Learned
Many lessons can be learned from these case studies that are applicable to the transportation sector and CDL data quality. Table 15 outlines key takeaways.

Table 5.3 Key Takeaways from Included Literature

Study	Takeaways
Zimbabwe	Data from multiple sources can strengthen missing or incomplete data
	Data integration can be done with both written and electronic data sources
RI 360	Engage policymakers and government leaders to understand needs
	Separate data sources can be collected and normalized
	State agencies can export data in various forms
WYDOT CV Pilot Program	Focus on interfaces
	Involve other agency departments
	Reimagine existing capabilities
	Use open-source software for integration
	Create user-friendly dashboards and tools for monitoring

Key takeaways from WYDOT's CV pilot project provide the most insights into technical aspects of data integration. The first suggests a focus on interfaces. By focusing efforts on which interfaces were necessary for the team to collect, manage, and interpret data collected by the CVs, WYDOT could determine which of its current applications could function without updates and which needed modifications or updates. Next, other departments within state agencies can be called upon for help with issues related to data integration as well as those surrounding the use of software and hardware applications. Another takeaway from this process is that existing systems should be assessed to determine

if capabilities match a need. Using an established system reduces training and maintenance needs. The use of open-source software is also suggested for creating a comprehensive system. This can generate cost savings because no licenses or software purchases are required. Last, user-friendly dashboards should be created to monitor software and hardware programs responsible for data collection and management. User-friendly dashboards can be an effective monitoring tactic and serve as a platform to communicate and interact with the public (Fok, Garcia, & Hartman, 2019).

Although not listed in Table 15, another takeaway is the importance of investing in resources. This project and other projects pertaining to CDL data quality are often funded by the Commercial Driver License Program Improvement (CDLPI) grant, which is available to all 50 U.S. states, Washington, D.C., and other entities with the capability to improve CDL data quality. This grant provides financial assistance to help states procure computer hardware and software and acquire personnel to complete testing and quality control measures (United States Department of Transportation, 2020).

All the projects began with varying levels of available resources and encountered different obstacles which hampered data integration. However, the goals of each project were the same: to improve an aspect of the human experience through increased safety measures or increased access to essential services. Each study indicates that data integration is a mainstay of improved data quality. Challenges often faced by states related to CDL licensing are like those faced by researchers in Zimbabwe, Rhode Island, and Wyoming. Missing or incomplete data and limited personnel are two issues state agencies face which prevents the improvement of CDL data quality. Data integration has been proven as a successful way to improve data quality and should be considered as a pathway to improved CDL data quality.

5.3 Barcode Scanners to Improve Data Quality

Scanning barcodes on driver's licenses is one proven technique for eliminating human errors in data collection. A barcode scanner that interfaces with e-filing service providers lets police officers retrieve driver information and their record in real time. Data are loaded to the system instantly and police officers have access to up-to-date information, which reduces the risk of criminal records or multiple state-issued licenses going unnoticed. When a law enforcement officer is equipped with a working portable printer, a summary of the citation can be printed for the driver. The process is as follows:

1. The police officer scans the driver's license.
2. The driver's information is uploaded to the e-filing software.
3. Law enforcement submits the violation.
4. A police officer prints a summary of the violation along with a tracking number for the driver.
5. The driver can pull up the detailed version of the violation online.

Scanning a driver's license prevents inaccurate submission of data by the issuing police officer. Using scanners to enter driver information eliminate human error. Using a scanner also helps officers check data in real time, provides safeguards against duplication of records, and lets officers take immediate action if necessary. Smart cloud services can then upload scanned data instantly into a designated software program. With the use of cloud services all agencies have access to this information in real time. Using scanners allows problems with data quality to be noticed much faster and help agencies come up with countermeasures to prevent issues from recurring. Since all agencies receive data from the point of occurrence, data can remain consistent.

Scanners also improve data quality by reducing lag time between the issuance of a citation and delivery to the courts, which can help states meet their 10-day processing requirements for updating the driving record of CDL holders. When officers write paper citations, they are responsible for completing the paperwork and making sure the citation is hand-delivered delivered to the county clerk's office. Every paper citation in Kentucky is a carbon copy packet that has 5 parts: Court, Court/Police 2, Violator, Detention, and Agency. The county clerk receives the Court and Court/Police copies and the driver in violation receives the Violator copy. If the driver is arrested, the jailing facility receives the Detention copy (if not, the officer may keep the copy or discard it), and the officer keeps the Agency copy for their own records. The county clerk is responsible for mailing the Court copy to the Kentucky Administrative Office of the Courts in Frankfort, Kentucky, where it is uploaded into the database once received and processed. (Truesdell, 2020). Because of the many steps for getting paper citations to court databases, there are multiple areas where pertinent data could be lost or destroyed before ever making it into the appropriate driving record and court databases. In addition to improving data quality, scanners can reduce the likelihood that citations will be dismissed in

court. Spelling errors and illegible handwriting can result in invalid citations, which directly impact revenue generated from citations (L-Tron Corporation, 2014).

A 2D barcode scanner is required for driver licenses and prices vary by capabilities and manufacturer. The data sheet for the 4910LR-151-LTRK, a microphone-style driver's license area imaging scanner from L-Tron Corporation, is depicted in Figure 6 and is as an example of the kind of technology available to police agencies. According to l-trondirect.com, the scanner currently retails for $378.00.

Figure 5.2 4910LR Scanner

5.5 Citations on Federal Lands

We interviewed staff members in DDL and the CDL Administration Section to better understand how CDL-related data quality issues challenge daily operations. One challenge is reporting on citations written for traffic offenses that occur on federal lands. Government agencies do not process traffic citations issued on federal lands and do not send traffic citations to DDL quickly. Instead, the Central Violations Bureau (CVB) — the government agency that administers this information — sends a large batch of citations to DDL at unpredictable intervals (e.g., once every three to six months). Also, the citations are on paper-based, not electronically reported. Processing paper citations creates a significant amount of work for DDL agents as they must update driver records with every citation received. DDL expressed concerns that this is an overlooked data quality problem, mainly because the citations are often months old. While most citations are for standard license holders, they can include citations written for CDL holders. Due to the CVB's unpredictable schedule for sending the tickets, serious offenses may not be added to a CDL holder's driver

history record for several months. The consequence of the unpredictable and antiquated process is that states have difficulty complying with FMCSA's 10-day reporting requirements for CDL-related infractions because data are not shared in a consistent, efficient, or timely manner. DDL staff members asked our research team to explore the reasons for this unpredictable schedule and to identify ways to improve the process.

5.5.1 Federal Lands in Kentucky
There are 1,718 square miles (1,100,155 acres) of federal lands in Kentucky (Congressional Research Service, 2020). Federal lands in Kentucky fall under the jurisdiction of five entities (Figure 7): Department of Defense (shaded in blue), Department of Energy (shaded in apricot), Fish and Wildlife Services (shaded in orange), Forest Service (shaded in green), National Park Service (shaded in grey), and Tennessee Valley Authority (shaded in teal). According to DDL and CDL section staff members, the most likely sources of citations are the National Park Service and military bases.
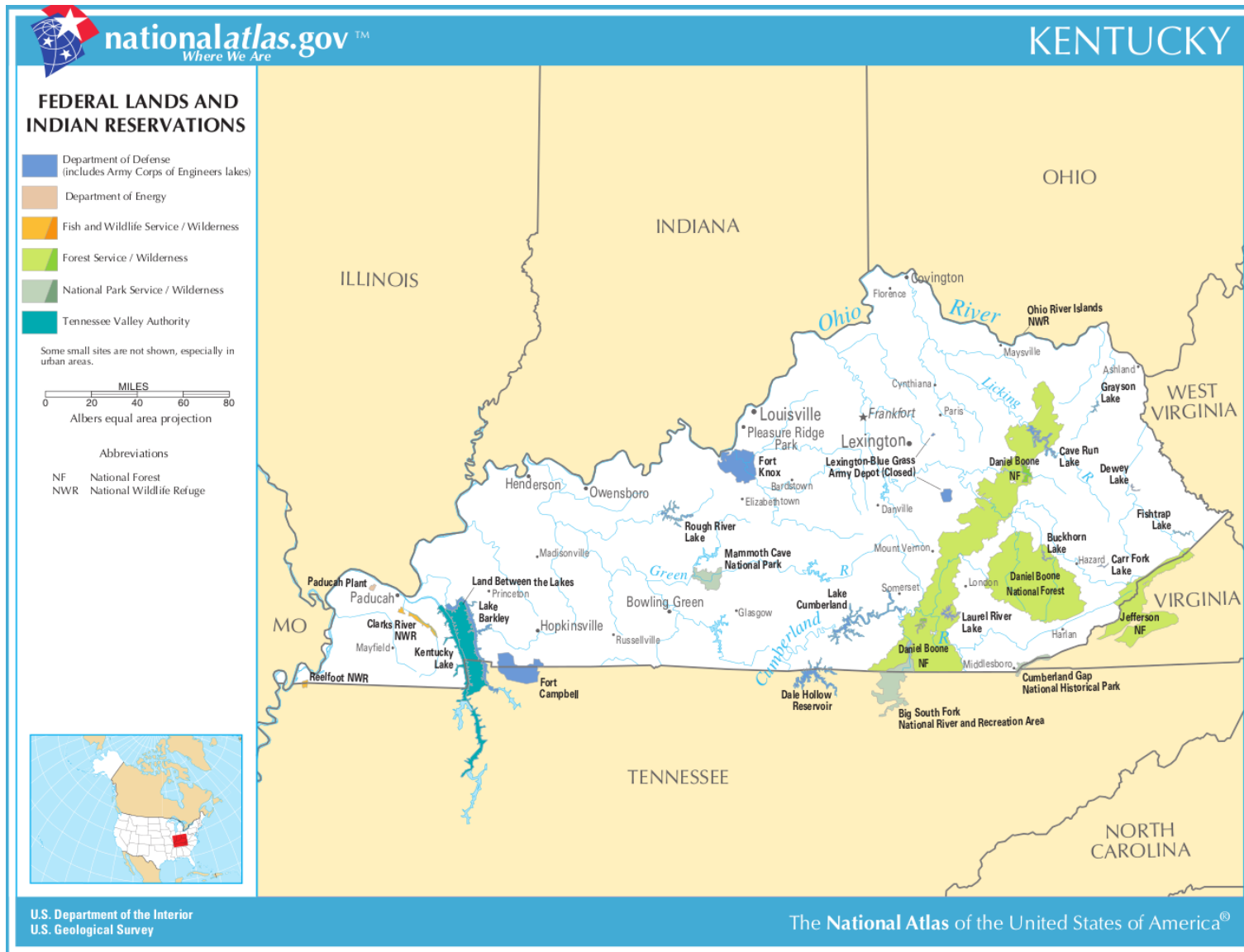
Figure 5.3 Federal Lands in Kentucky

5.5.2 Central Violations Bureau (CVB)

CVB is the national center responsible for processing violation notices issued for petty offenses on federal property. A petty offense under federal law is a misdemeanor that can include a penalty of jail time but is usually accompanied by a penalty of a fine and court costs. A traffic citation is a petty offense (CVB, 2020). CVB does not issue the citation; representatives of the federal agencies that own the land issue tickets. The agency then submits the original citation to CVB, and CVB enters the ticket into their database. CVB issues the Notice to Appear in court by mail and tracks the case until the offender pays the fee or the case is adjudicated in court.

All federal tickets are adjudicated through U.S. District Courts. Some of these citations are pre-payable while others require a mandatory court appearance. Offenders have the option to pay online or by phone, check, or money order. If the offender pays the ticket without appearing in court, the offender is pleading guilty. Offenders can also contest the citation in court, but they do not receive a court date until four to eight weeks after the citation is issued. If the offender does not make a payment or appear in court when required, the court can issue a warrant for the driver's arrest and report the failure to appear or failure to pay to the driver's state motor vehicle agency. Traffic offenders cited on federal lands have the option to make special requests (e.g., traffic school) during their court hearing, although CDL holders do not have this option. The consequences of failing to pay citations are quite serious. CVB assesses delinquency and default fees and sends these to the Department of the Treasury for collection. CVB sends funds collected from these citations to the Crime Victims Fund and distributes them to states, where they are used to compensate crime victims.

A member of our research team contacted CVB to gather more information about federal citations. A CVB representative noted that the decision to submit any citation on federal land to state officials is up to magistrate judge at every state court. Federal district judges appoint magistrates. The same representative said they do not always submit the infraction to state agencies, so it may not appear on the driving record. There is no specific guideline on what violations are reported or not reported to state agencies. CVB is thus unable to expedite the process because the data sharing authority is vested with the magistrate judge and not the agency.

5.6 Conclusions

Processes followed when issuing and tracking federal citations poses data quality challenges for SDLAs. Not all citations on federal lands are submitted to states as federal magistrates for district courts have discretionary authority and can determine whether to forward the citations to state agencies. With no standards or guidelines, it is unclear whether all CDL-related cases are being sent to the SDLAs. It is also not clear what types of citations are sent to SDLAs for standard operator licenses. Therefore, educating federal magistrates about the importance of enforcing CDL regulations and the challenges that SDLAs face in meeting the 10-day reporting requirement is the first step toward improving the reporting process for federally issued citations. Another solution is to change reporting requirements. Ideally, an electronic citation system that could interface with SDLA databases would enhance data quality. Furthermore, changes to reporting requirements could also be helpful. One solution is to require efficient reporting of all CDL-related infractions to CVB or SDLAs.

Chapter 6 Funding Mechanisms and Personnel Issues

6.1 Introduction
It is imperative for transportation agencies and courts across the U.S. to update their current systems and practices for collecting and using CDL data. As it stands, current efforts to improve these processes are stunted by lack of resources, both financial and staffing. Identifying funding mechanisms to update data management systems is crucial for a multitude of reasons.

6.2 Time Management
Securing funding to update current practices related to CDL data quality is arguably the most important step agencies can take to improve overall time management. Having adequate funding mechanisms in place lets state agencies focus resources on securing IT professionals who can improve processes and reduce the amount of time personnel spend on administrative tasks. For instance, Kentucky has improved CDL administration processes for CDL applications (first-time applicants only), CDL self-certification (which must be filed every two years), and medical cards (which also must be filed every two years after a physical examination by a certified medical examiner). The application, called myCDL, allows individuals to file these electronically such that they are automatically batched to the system (Commonwealth of Kentucky, 2020). Prior to this upgrade, agency personnel had to process documents emailed, mailed, or faxed to them, which required administrators to re-enter relevant data fields. Having multiple entry points for data led to data quality issues and wasted both time and money on administrative processes that could be streamlined. Additionally, these updated processes have reduced the number of phone calls made to CDL offices across the state. Ultimately, securing funding can improve current technology and automate redundant processes, thus reducing the administrative burden.

6.3 Securing Versatile IT Professionals
A 2019 report by the U.S. Government Accountability Office found that the USDOT ranked seventh out of ten identified federal agencies in most need of upgraded IT infrastructure. The metrics used to measure the need for modernization included system age, age of the oldest hardware used, system criticality (as determined by the agency), and security risks (as determined by the agency). Unfortunately, the report documented that USDOT was one of three agencies with no modernization plan for its IT systems (United States Government Accountability Office, 2019). In addition to lagging federal plans and infrastructure, state and local agencies also continue to operate with antiquated systems. Kentucky's driver license information system (KDLIS) is written in an old COBOL mainframe programming language. It is no longer taught in university computer science programs and most of the programmers who know the language are near, at, or past retirement age. With retirements looming, it is imperative that Kentucky invest resources in additional programmers who can retain the institutional knowledge and simultaneously work to upgrade systems to newer, cloud-based applications.

6.4 Improvement of Services
The covid-19 pandemic has strained many government agencies in the U.S., but none more so than state unemployment offices. Outdated systems with limited capabilities have been overrun in recent months by the more than 27 million unemployed Americans (Li, 2020). Prior to the covid-19 pandemic, Kentucky's state unemployment system was run by 12 individuals. Due to the volume of claims, Kentucky hired an additional 1,000 personnel. Inadequate training of new employees coupled with high internet traffic and call volumes further strained the system (Mackrael, 2020). Furthermore, a data breach in April 2020 in the state unemployment system exposed the personal information of many individuals to other applicants. There are still Kentuckians who have yet to receive a single payment (Sonka, 2020). The continued use of outdated systems will prove costly to both individuals and the state. Recent problems with the unemployment system highlight how government agencies are forced to pay in one way or another. Kentucky did not invest appropriate resources to upgrade antiquated systems and then had to pay for additional personnel to keep up with demand. Similar problems have been seen in Oregon. As part of the American Recovery and Reinvestment Act of 2009, Oregon received $85 million to upgrade its computers (ARRA, 2009). But the state has made little effort to upgrade unemployment systems and experienced a recent influx of covid-19-related unemployment claims. State officials had begun the process of upgrading systems in weeks leading to the pandemic, but said these efforts could total over $100 million and take several years (Thomas, 2020). Although the current circumstances were unforeseen, these examples should serve as a lesson to other government agencies on the importance of securing funding to implement necessary upgrades to prepare for worst-case scenarios. State agencies

that provide services to the public should strive to provide the best experience possible for those on either side of the interface.

Currently, discussions are ongoing about providing funds for improving state unemployment systems as part of the current covid-19 stimulus talks (Stein & Werner, 2020). Given the pandemic's effect on state budgets and resources, it is increasingly likely that the best way to ensure all states make sufficient upgrades is federal provision of aid that is earmarked for targeted improvements. To realize the greatest improvements in efficiency and data quality, it is critical that all states make necessary upgrades. Lawmakers and stakeholders should consider taking similar steps to meet resource needs for state transportation IT systems. State transportation agencies must identify funding sources (federal or otherwise) that will allow them to improve their current processes. As it stands, CDL data quality continues to suffer. Investing resources into versatile IT professionals and modernized data management systems will facilitate the collection of quality data and improve the services and experiences of all involved.

6.5 Compensation for IT Employees
Fixing issues with CDL data quality will require more investment in technology and human resources. Government agencies oftentimes cannot compete with private sector pay and therefore commonly fail to recruit outstanding professionals with skill sets best suited to execute and enhance daily operations, system updates/upgrades, or data integration processes. For instance, Computer and Information Research Scientists are often well-equipped to develop and improve software and hardware applications, which is a necessary skill for updating antiquated systems and processes that many state agencies still employ. Table 16 outlines the median wages for computer and information research scientists from the United States Bureau of Statistics (United States Department of Labor, 2020).

Table 6.1 Median Annual Wages of Computer and Information Research Scientists in Top Industries

Software publishers	$141,820
Research and development in the physical, engineering, and life sciences	$134,490
Computer systems design related services	$129,290
Federal government, excluding postal service	$109,370
Colleges, universities, and professional schools; state, local, and private	$81,910

Source: May (2019)

Like computer and information research scientists, computer systems analysts are needed to make continuous upgrades and maintain computer systems. Computer systems analysts are responsible for incorporating new functions into existing systems, designing new systems by choosing appropriate software and hardware applications, and overseeing the implementation of these new systems. Most computer systems analysts are experts on the systems used by their organizations and provide invaluable knowledge for uses and potential merges for improving workflow processes and data quality. Table 17 lists the median wages as of May 2019 for computer systems analysts from the United States Bureau of Labor Statistics (United States Department of Labor, 2020).

Table 6.2 Median Annual Wages of Computer Systems Analysts in Top Industries

Information	$93,710
Computer systems design and related services	$93,280
Management of companies and enterprises	$93,220
Finance and insurance	$92,000
Government	$80,570

According to the United States Bureau of Labor Statistics, median wages for computer and research information research scientists and computer systems analysts are generally higher in the private sector than in the public sector. Higher salaries in the private sector can be an obstacle for government agencies that do not have the resources to compete, lessening the chances that the most sought-after employees will choose positions in the public sector. The Federal Employee Viewpoint Survey revealed that the public sector falls short of the private sector in workplace quality. The Best Places to Work employee engagement score for 2019 was developed by combining answers from the following survey items on the federal survey:

1. I recommend my organization as a good place to work.
2. Considering everything, how satisfied are you with your job?

3. Considering everything, how satisfied are you with your organization?

The mean private sector employee engagement score was 77 out of a 100 and the public sector's mean score was 61.7. Clearly, the public sector has much work to do in the future to recruit and retain talented IT professionals. Table 18 outlines specific areas in which the public sector did not perform as well as the private sector (Overall Findings and Private Sector Comparison: A look across the federal government, 2019).

Table 6.3 Comparison of Public to Private Sector Employee Satisfaction

Topic	Public Sector	Private Sector
Percent of employees who believed the results of the survey would be used by leadership to improve working environments	37%	67%
Percent of employees who reported having trust and confidence in their supervisors	69%	82%
Percent of employees who reported being satisfied with their immediate supervisors	71%	81%
Percent of employees who reported feeling recognized for providing high-quality products and services	51.6%	67%
Percent of employees who reported feeling encouraged to come up with new and better ways of doing their jobs	61%	75%
Percent of employees who reported that their supervisors supported their development	67.3%	74%
Percent of employees who reported being satisfied with training they received	55.3%	66%

The survey results provide valuable insights into factors public agencies should take into consideration when recruiting and retaining IT professionals. It also reveals that most shortcomings in the public sector revolve around employee management, suggesting that salary discrepancies are not insurmountable barriers.

6.6 Recruiting
According to Elliott and Reynolds III (2014), 25 percent of graduating college students list working in government as their top three choices for a career path. However, the National Association of Counties reported 83 percent of county government agencies in the U.S. paid their employees less than $47,500 on average (National Association of Counties, 2018). Despite this challenge, listed below are some ways that government agencies can compete with the private sector to recruit IT professionals (Maciag, 2013; Monster Government Solutions, n.d.; National Association of Counties, 2018; Ramsey, 2020).

1. Link with local colleges/universities to offer paid internships in government agencies
With one-fourth of graduating college students expressing interest in working at government agencies, the opportunity exists for these agencies to collaborate with local colleges and universities by offering paid internships to students interested in public service. This collaboration lets more potential employees become familiar with the inner workings of the agency and provides valuable experience. Furthermore, students can participate in government work that impacts communities in real time. This experience can provide benefits to both potential employees and government agencies (Maciag, 2013).

2. Use social media to advertise open job positions

Monster Government Solutions, a subsidiary of Monster (online employment platform) teamed with Market Connections to conduct a survey of human resources (HR) professionals in the U.S. Data showed that private sector HR professionals were twice as likely to use online platforms, including social media, when recruiting employees. Conversely, most federal government jobs (75 percent) are posted on USAJOBS (www.usajobs.gov) which is used much less by the current workforce. Human resources professionals in the public sector should be willing to use high-traffic platforms such as LinkedIn or Facebook (Monster Government Solutions, n.d.).

3. Focus on the agency mission

Government agencies often cannot compete on salaries, but showcasing the agency mission can potentially bring in employees excited about engaging in work that directly impacts their community. San Diego County, California, produces videos outlining job descriptions for potential employees (National Association of Counties, 2018). This novel approach can be vital for providing insights into working at government agencies and is not commonly used. Additionally, this approach shows potential employees that government agencies are willing to go further to share their missions and get individuals excited about working toward completing those missions.

The city of Denver, Colorado, began a branding campaign in 2016 to encourage individuals to apply for city government jobs. The slogan, "Be a part of the city you love," was featured on billboards, social media, and city buses. In just one year (2018-2019), Denver saw a 19 percent increase in overall applications to government agencies, and an increase of 20 percent in first-time applicants (Ramsey, 2020).

4. Employ HR tools to streamline hiring process

Although millennials are projected to make up 75 percent of the total workforce in the United States by 2025, they currently comprise just 27 percent of public sector employees (Ramsey, 2020). One of the main reasons for this is lags in hiring times. According to a 2014 article on *Governing*, the city of Austin, Texas, requires an average of 240 days to complete the hiring process for an open technology position, with similar times in other major cities around the U.S. Furthermore, a survey of 200 HR professionals revealed that only 29 percent of HR professionals in the public sector were satisfied with the tools currently used in the hiring process, and 32 percent suggested that the current technology used in the hiring process negatively impacted applicants. Because the private sector often spends more resources recruiting job seekers than the public sector, hiring processes are much faster. By focusing efforts on improving lag times between hiring decisions and improving the HR technology, the public sector can become much more competitive in recruiting IT professionals.

6.7 Retention

In a job market where millennials will soon be the predominant part of the workforce, special efforts should be taken to retain them. Unlike generations before them, millennials are not interested at staying in one position for a lifetime. In fact, 21 percent of millennials interviewed in a Gallop poll switched jobs after just one year compared to non-millennials at 7 percent. More than half of millennials reported not feeling engaged with their employers (Adkins, 2016). Government agencies should take special care to foster the new dynamic workforce by offering benefits and employee training programs that reflect their needs. Table 19 outlines millennial priorities for the workplace (Gantz, 2016).

Table 6.4 Millennial Workplace Priorities

1. Teamwork
2. Appreciation and support for contributions
3. Flexible work schedule

In addition to these priorities, millennials report they would commit to a decade of work with a single employer with yearly salary increases and the ability to advance in the organization (Overfelt, 2017). Based on this information, the following strategies can be used by government agencies to retain valuable employees.

1. Improve knowledge transfer between employees

According to the Office of Personnel Management, nearly 60 percent of all federal employees are 45+ years old (OPM, 2017). With a wave of retirements coming soon, it is critical for government agencies to begin the transfer of information from employees that are leaving to those that are just beginning. Creating partnerships between these working groups can bridge the gap in knowledge that will inevitably come when decades-long employees retire. The

transfer of information can help new employees navigate workplace cultures, understand current systems and processes, and develop relationships early on that will leave new them feeling engaged in their workplace. This transfer ultimately will provide new employees with the information they need to begin their new positions.

2. Recognize and reward employees

Although many government agencies cannot compete with the private sector by providing competitive salaries or raises, there are other ways to recognize and reward employees that will result in retention. A 2017 Forbes article lists multiple ways supervisors or managers can reward employees without spending money (Ryan, 2017):

- Allow employees to work from home
- Allow employees to have a flexible work schedule
- Ease/remove dress codes
- Schedule regular one-on-one meetings with personnel
- Provide regular praise to employees
- Put trust in employees to do the job they were hired to do

3. Develop career tracks

Employees are more likely to be satisfied in the workplace if they understand how their role contributes to an agency's mission. By creating work plans with clearly outlined goals, employees understand the expectations and what steps are needed to reach those goals.

4. Involve employees in workplace processes and improvements

Employees should be involved in any processes focused on changing or improving workplace processes (Maciag, 2013). IT employees, however, bring invaluable knowledge and skills to government agencies and can help direct new processes and incorporate systems to improve daily operations. Additionally, IT professionals can bring previous experience that may benefit the agency's mission. All employees can offer insights into how improvements can be made based on their personal experiences. Any changes should include input from them.

6.8 Conclusions

Recruiting and retaining IT professionals at local and state transportation agencies can be challenging because of low budgets and antiquated processes, but many viable options exist to overcome those challenges. Many issues government employees find troubling are not related to compensation, but rather to management and employee engagement. Because IT professionals play an outsized role in identifying and implementing new programs and processes, understanding how to best serve them is imperative to both their success and the quality of data being produced and maintained. By incorporating some of the proven strategies mentioned above, recruiting and retaining valuable IT professionals in state and local transportation departments for the long-term is possible, even in a highly competitive market. Transportation agencies across the U.S. have been tasked with improving CDL data quality. Oftentimes these agencies are not properly funded and lack the appropriate resources to recruit and retain valuable IT professionals. While there may be no immediate way to increase compensation for this group, there are many other ways management-level personnel can increase engagement and productivity. Government agencies must be willing to make the satisfaction of IT employees a top priority.

Chapter 7 Best Practices

7.1 Introduction
Based on our team's research, we developed a list of best practices to improve CDL data quality. Given that SDLAs are responsible for issuing most licenses, as well as processing and oversight, it falls to states to implement most of these changes. Nevertheless, the federal government has a vital role to play in furthering several best practices by standardizing processes or providing resources that will help states improve their CDL data quality. True, obtaining federal funds to address these challenges may pose challenges, especially given the funding constraints most state DOTs face from stagnating road fund revenues and budget cutbacks resulting from covid-19. One mechanism to help states institute these best practices is to redefine national priorities for national grant programs, such as the Commercial Driver's License Program Implementation (CDLPI) grant. While CDLPI provides many resources to maintain compliance with current FMCSA requirements, systematic program improvements would likely require more funding than the $32.7 million in awards anticipated by FMCSA for FY2020.

7.2 ACD Equivalency Standardization
As part of its CDLIS management efforts, AAMVA initially maintained the ACD equivalency table administrators used to easily translate an out-of-state traffic citation to an equivalent charge in the state where the license was issued, thus allowing for updates to the individual's driver history record. In 2008 AAMVA stopped maintaining the table, its administrators contending that states were not making timely updates to changes in state traffic laws, making it difficult to keep the ACD equivalencies current. As a result, court records administrators at SDLAs frequently have to call other states to get the correct ACD equivalency, which slows the reporting process. Reporting delays impact data quality for all licenses issued, including CDLs. There are private sector publications, such as *MVR Access and Decoder Digest*, which contain information on ACD equivalencies for some states but is missing data for others. To improve the timeliness and compliance with the 10-day record processing window, AAMVA and SDLAs should partner to consider how these codes can be updated quickly to reduce reporting delays. A best practice is establishing stronger requirements for states making changes that impact ACD equivalencies, and for AAMVA to resume maintaining an equivalency table.

7.3 Enhanced CDL Data Quality Metrics
FMCSA provides states with monthly reports containing for each state data quality metrics for timeliness of convictions, withdrawals, duplicates, and transfers. There are also measure of data quality for history, convictions, withdrawals, updates to personally identifiable information, state of record, pointer deletions, and negates. It also contains a matrix of state CDLIS capabilities for various updates and requirements. These measures are quite useful because they let states track their performance over time and compare themselves to other states. Another best practice recommendation is having states expand on these data quality metrics to include additional measures of data quality based on enforcement and adjudication workflow processes that precede the driver history record processes, which generally happen in the latter stages of the traffic enforcement process. Data quality could include validity, accuracy, and completeness of traffic citations; accuracy and timeliness of court actions; and assessments of automated processes and equipment that could reduce the number of data quality issues pertaining to CDL-related records. States could implement these separately or as a cooperative effort between law enforcement agencies, traffic courts, and SDLAs. Across states with common software applications or systems it may be possible to compare metrics. In other instances, many enhanced metrics will require enhancements to data collection processes and reporting tools.

7.4 Inclusion of a CDL/CMV Indicator for E-Citation and Court Case Management Software
The survey of other states revealed how difficult it is for researchers, administrators, and analysts to collect and analyze data. Most e-citation and/or case management databases do not have an indicator that distinguishes citations issued to a CDL holder versus someone with a standard operator's license, and whether the license was issued to someone operating a CMV (which in some cases does not require a CDL endorsement). As a result, court records analysts cannot isolate traffic citations issued to this class of driver from standard operators, which makes it difficult for FMCSA and other stakeholders to analyze the enforcement and adjudication of traffic infractions in the overwhelming majority of states.

The e-citation software used by KSP requires officers to indicate whether the vehicle cited is a CMV and whether the driver has a CDL endorsement. These data fields are passed along to the Kentucky Administrative Office of the Courts, which can create queries that isolate a specific class of driver and vehicle, allowing researchers to investigate trends

in enforcement and adjudication. A 2020 Kentucky Transportation Center study found that from 2007 through 2016 there was a significant decline in the number of citations written for specific ACD violation types committed by individuals with a CDL endorsement and/or operating a CMV (Koo et al. 2020). Convictions rates have also been falling while dismissals increase, which is raises concerns about the potential safety impacts of these trends (Koo et al 2020).

Washington state court administrators also provided data on CDL-related violations for traffic infractions and criminal traffic violations between 2006 and 2015. The Washington data were more limited in scope because their analysts could only provide data for charges applicable to CDL holders (i.e., charges that would not be applicable to individuals with a standard operator license). The number of CDL-related charges increased from 2005 to 2015, though mostly based on large increases in two specific infractions — using a cell phone and texting while operating a CMV (Koo et al. 2020). CDL charges classified as traffic infractions had higher conviction rates and lower dismissal rates; those classified as criminal infractions (i.e., more serious charges) had lower conviction rates and higher dismissal rates. Given that criminal convictions generally have more severe consequences for drivers, lower conviction rates are not a complete surprise. However, conviction rates for criminal violations steadily declined during the study period, which is concerning. Another point of concern is the prevalence of cellphone use by CDL holders, which is undoubtedly a significant safety hazard (Koo et al. 2020).

States will benefit greatly from collecting data on the CMV/CDL indicator. The fields should be added to the user interfaces of e-citation software law enforcement agencies use, and the data fields should be imported into the CMSs. The field should also be mandatory so there no issues related to completeness or validity arise. These changes will let state and federal analysts track both enforcement and adjudication of CDL laws and regulations as well as how traffic laws and regulations are applied to CDL holders and/or CMV operators. Some states we initially surveyed in 2017 communicated plans to add such an indicator, but follow-up conversations with Michigan, Minnesota, and Utah staff revealed little if any progress on that front. This type of reporting change will give highway safety stakeholders much better insights into the efficacy of state and federal CDL safety policies.

7.5 Reduce Data Entry Errors through Automation, Streamlining and Reporting Standards
While CDL data entry errors happen for many reasons, two actions are critical for reducing them: 1) automating as much of the data entry process as possible, and 2) when automation is not possible only enter data a single time. One of the main ways to automate data entry for CDL-related citations is to ensure that all law enforcement officers at state and local agencies have driver license scanners that populate the driver name, date of birth, license number, state, address, issuance date, expiration date, and any other field on the physical license itself. Importing data into e-citation software in this manner is much more accurate and less prone to error than manual data entry as it precludes a transcription or keying error. The accuracy of the source data for licenses is crucial because it is run against the Problem Driver Pointer System, National Driver Registry, and the National Crime Information Center stolen vehicle file, among other state and federal systems. At every step in the process, data exchanges should be automated so that when information moves between state and federal agencies data re-entry is not needed. Where automation is not possible, the single data entry point needs to be emphasized. Once data are collected they should not be re-entered. Not only are such processes inefficient — they also greatly increase the chance of making a data transcription error. Kentucky has reduced its reliance on data re-entry significantly via use of the myCDL portal for CDL self-certification and medical card renewals. Before its implementation many of those documents were mailed, faxed or e-mailed, which in turn had to be re-entered into the system. Using online web services precludes the need to read handwriting that is sometimes difficult to discern or re-enter or copy typed information into the relevant database application. Once a field is collected it should automatically be passed along to other stakeholder applications that require the field later in the process. For example, when a court adjudicates charges that impact a CDL holder's driving record, every effort should be made to make record changes electronically rather than mail a court order than has to be entered manually.

Standards for data exchange should be well-defined and mandatory for all stakeholders exchanging data. Each field should have a clearly specified format, particularly for standardized identifiers like date of birth, driver license number, address, and vehicle information. Field formats should be clearly designated as numbers or strings, and the number of characters and character sequences should undergo validity checks where they can be standardized (e.g. MM/DD/YYYY for date of birth, and state-specific sequences for driver license numbers, like a single letter followed by eight numbers in Kentucky). Standards for state statutes, traffic codes, and uniform criminal code reporting (e.g., UOR codes in Kentucky) should be standardized and shared with all jurisdictions. In sum, SDLAs, court systems and

law enforcement agencies should automate data collection whenever possible, eliminate data re-entry whenever possible, and work together to standardize data fields so that electronic file batching between systems is easier.

7.6 Invest More Resources in Mainframe/IT Upgrades

Many state driver license information systems are built on outdated technology. These aging mainframe systems, usually written in COBOL, are quite limited in terms of functionality, adaptability, and performance. Interviews with Kentucky officials have revealed that it is difficult to find programmers knowledgeable in COBOL as it is an outdated programming language no longer taught in most university computer science programs. The system's functionality is therefore limited due to limitations in the underlying software and firmware capabilities. These characteristics also influence performance limitations. Only a limited number of users can be in the KDLIS system at a particular time, which can slow down certain workflow processes. Limitations in the number of characters that can be stored for each driver file make it impossible for administrators to distinguish a landline number from a mobile number or to collect e-mail addresses. Consequently, DDL generally lacks the ability to send electronic reminders or communications to drivers.

States still making use of outdated mainframe systems need to make investments to upgrade their driver license information systems. At most state DOTs, the critical infrastructure used to manage administration of driver licenses, vehicle registrations, and motor carrier tax filings and credentials are not considered critical infrastructure akin to highway or multimodal construction, but these systems have been neglected for so long that upgrades are now of critical importance. A few states are beginning to upgrade their systems, and in some instances RFPs issued for vendors of DMV modernization systems have been made public (Younkin and Townsel 2018). As noted in Chapter 6, the GAO report found that federal transportation agencies also need to upgrade and recommended they develop modernization plans.

Upgrading driver license information systems will likely be cost prohibitive for many states, especially given budget reductions spurred by covid-19 and the lack of financial assistance to state and local governments to stabilize collapsing revenues. However, the human costs of not making such investments have become apparent as they relate to state unemployment benefits. During both the Great Recession and the covid-19 pandemic, the federal government provided financial assistance for states to make changes or upgrades to their unemployment information technology systems. Unfortunately, states have not made the improvements necessary to disburse expanded unemployment benefits in a timely fashion to the millions of individuals who have lost jobs. Just as making investments in public infrastructure has costs, so does not making such investments.

Upgrading IT will also yield benefits that would accrue to states and all stakeholder agencies, not to mention all recipients of driver licenses — not just CDL holders. However, if FMCSA and other federal stakeholders want to maximize the potential benefit of these investments, federal assistance is needed to finance upgrades and maintenance. If only a small number of states complete these upgrades in the near future, it will be more difficult to maximize their potential benefits, including more dynamic systems with greater bandwidth and functionality, so that electronic DMV services can be expanded and upgrades and maintenance done in a less painstaking and costly manner. USDOT should create a modernization plan for its own systems and work with states to create one for their systems as well. These plans should include the functionalities, technical specifications, and estimated costs, among other things specified in the 2019 GAO report.

7.7 Increase Investment in IT Personnel

Compensation for IT employees in the public sector lags the private sector. Not only are private sector organizations able to pay more money than government organizations, they invest more resources to recruit top graduates. Private sector IT workers also have higher levels of job satisfaction than public sector employees. Fringe benefits, such as pensions and more favorable student loan forgiveness terms (such as the Public Service Loan Forgiveness program) have been offered as incentives to offset the allure of higher pay in the private sector, but the uncertainty around the unfunded liabilities of public pensions and the exact parameters of the student loan forgiveness programs may make those incentives less enticing than public officials had initially hoped. The environment makes it more difficult for SDLAs or state DOTs to recruit the IT personnel needed to upgrade and maintain systems related to driver licenses, vehicle registrations, and other vehicle regulation activities.

Some analysts or policymakers contend that one way to deal with the personnel challenges is to outsource more functionality to private-sector vendors, whereas others prefer to keep such functionality in-house. Our survey of state

courts revealed a roughly even split in preferences. Despite the small response rate to a survey of SDLAs, there was a clear preference for in-house functionality. However, we have observed some limitations to that approach over the years. First, private-sector vendors are not always cheaper than in-house developers. Second, the outcomes of these partnerships vary in terms of state administrator and customer satisfaction with the software or hardware applications and vendor services. Third, even if agencies outsource some application development and maintenance to vendors, they still must retain enough institutional knowledge and expertise to properly evaluate the work done by vendors to ensure compliance with contractual obligations and, more importantly, with agency requirements. On the other hand, agencies developing products in-house often have trouble recruiting and retaining personnel with sufficient experience and expertise to build needed systems. Developing a new application from scratch may require a large amount of unnecessary work, particularly if an existing product can meet agency needs.

State transportation agencies need to place greater emphasis on recruiting and retention. Pipelines from local colleges and universities might be fruitful. More aggressive recruitment on social media can also prove beneficial. Identifying people who are interested in working in the public sector and making it easier for HR departments to hire employees is also critical. Administrators in the Department of Vehicle Regulation have reported that HR processes can take several months to complete, which makes it difficult to fill vacancies. In some cases, by the time an official job offer can be made, the individual has accepted a job elsewhere. States should look at implementing these steps to help with IT employee recruitment in all agencies, not just those dealing with CDL administration and enforcement.

Retention is the other key component to personnel quality. Research indicates millennials have different workplace priorities (e.g., interest in teamwork, appreciation for their contributions, and a flexible work schedule) and catering to these can facilitate retention efforts. The OPM study cited in Chapter 6 shows that administrators should improve knowledge transfer between employees, recognize and award employees, develop career tracks so individuals can advance in their fields, and involve employees in workplace processes and improvements.

The issue of increasing compensation immediately raises the question of how to make such investments. In light of current fiscal constraints, securing funding may be difficult. However, states should consider policy alternatives (e.g., diverting state road funds into a technology fund that can be used to bolster the performance and functionality of public-facing IT systems). Another alternative is using a dedicated transaction fee. Several SDLAs already have dedicated fees for electronic transactions, but generally do not devote them specifically to IT infrastructure development and maintenance. Without a fiscal solution, SDLAs can implement other recruitment and retention strategies at little to no cost.

7.8 Reducing CDL Masking and Extending Outreach to Law Enforcement and Adjudicators
Administrators in the Kentucky Department of Vehicle Regulation's Court Records Section closely monitor local court adjudication of traffic infractions involving CDL holders to ensure that courts comply with federal regulations that prohibit diversions or other court maneuvers that mask the violation on the driver record. Where courts have incorrectly applied diversions for CDL holders, administrators are still indicating the charge on the driving history record. Such monitoring reduces the risk of masking, but there is always a possibility that a masked charge will slip through. CDL administrators are also concerned about masking at the behest of local prosecutors. Currently CDL holders cannot take the traffic diversion program classes offered by local prosecutors and must attend the state class. However, there have been known instances of non-compliance with this requirement. Additionally, prosecutors have the added ability to drop charges at their discretion, and in the case of CDL holders a dropped charge is not considered masking, even if the driver actually committed the infraction.

Reduced masking can be achieved if court records administrators in every state closely monitor court adjudications of CDL charges. Kentucky administrators have been tracking instances where diversion or actions that mask charges and have been applying the infraction to the CDL holder's driver history record to comply with federal regulations. This practice sometimes engenders pushback from individual drivers or the local court system, but the consequences for non-compliance carry a heavy penalty, including the loss of some state FHWA road funds. State administrators should ensure that court records databases clearly flag the CDL holder records so that impacts to CDLIS can be easily reported and additional scrutiny applied to prevent masking incidents from occurring.

State SDLAs and DOTs need to make a much more concerted effort familiarize state and local court officials — including both judges and prosecutors — with federal requirements and the safety objectives of FMCSA's policies.

Martin et al.'s (2015) study of trucking industry credentialing, permitting, and tax violations found that judges in counties where such citations were issued more frequently (i.e., counties with weigh stations or large volumes of truck traffic) were more likely to uphold convictions compared to judges in counties where such violations are less frequent. Familiarity with interjurisdictional agreements (e.g. IRP, IFTA) and federal regulations tended to yield higher conviction rates. Koo et al. (2020) found a similar pattern for CDL adjudication. Counties with a weigh station or near a major interstate tended to have higher conviction rates than other counties. Communicating these requirements and their applicability to highway safety as part of continuing legal education, conferences, and other venues will be helpful for judges, local prosecutors, and law enforcement officers.

7.9 Standardization of Central Violations Bureau Reporting
USDOT officials and SDLAs should begin a dialogue with the five stakeholder agencies who report traffic infractions to the Central Violations Bureau. The Department of Defense, Department of Energy, Fish and Wildlife Services, the U.S. Forest Service, and the National Park Service should make plans to implement timely reporting of traffic infractions to states as these are required to update driver history records. A special point of emphasis should be citations issued to CDL holders and/or persons operating a CMV. In turn, it would be helpful for these agencies to ask that any magistrate judge promptly submit CDL-related infractions because of the 10-day reporting requirements for these violations. Another, simpler solution might be to change the reporting requirements so that the officer, park ranger, or government official issuing the citation lets the state know if CDL regulations are impacted.

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