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MARYLAND MOTOR CARRIER PROGRAM SAFETY ASSURANCE EVALUATION

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NTIS Program Administrator
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Dear NTIS Program Administrator:

As specified in the Department of Transportation's *Reporting Requirements for University Transportation Centers*, enclosed is one copy of each of the final research reports by Dr. Dr. Bapna and Dr. Zaveri of the National Transportation Center (NTC) at Morgan State University.

Sincerely,

Andrew Farkas

Dr. Andrew Farkas
Director

Enclosures

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Technical Report Document Page

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16. Abstract

The State of Maryland is implementing the Commercial Vehicle Information Systems and Network (CVISN) architecture to enhance and support Commercial Vehicle Operations (CVO) administrative processes, improve roadside safety inspection operations, and implement electronic screening for commercial vehicles. It is anticipated that the deployment of CVISN will achieve measurable improvements in efficiency and effectiveness for commercial motor carriers, drivers, governments, and other CVO stakeholders.

The proposed study evaluates the safety assurance activities of Maryland's Roadside Enforcement Program due to the current implementation of CVISN-related computer and communications systems used to collect and distribute safety-related data. The safety-related activities mainly include the commercial vehicle and driver inspections at roadside weigh/inspection facilities and by roving crews in Maryland, and the collection and distribution of inspections. This study involves examining the following safety-related activities:

- Electronic collection of inspection data at roadside inspection facilities;
- Transmission of inspection data from roadside inspection facilities;
- Distribution of safety information to computers at the roadside.

The following criteria are evaluated for both electronic and manual inspections: throughput of commercial vehicles being inspected; efficiency and effectiveness of commercial vehicle and driver inspections in Maryland; availability of safety inspection data in a timely manner; driver and inspector satisfaction with the inspection process; completeness and accuracy of inspection reports; and the efficiency of uploading inspection data.

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ABSTRACT

The Commercial Vehicle Information Systems and Networks (CVISN) program envisions the development, design, and deployment of various technical devices and systems to benefit interstate and intrastate motor carriers, the state and federal governments, and other stakeholders. CVISN is an integration of information systems and networks designed to improve the performance of commercial vehicle operations (CVO) and add strategic value to the industry. CVISN includes information systems owned and operated by state and federal governments, commercial motor carriers, and other stakeholders.

The State of Maryland is implementing the CVISN architecture to enhance and support CVO administrative processes, improve roadside safety inspection operations, and implement electronic screening for commercial vehicles. It is anticipated that the deployment of CVISN will achieve measurable improvements in efficiency and effectiveness for commercial motor carriers, drivers, governments, and other CVO stakeholders.

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PART I

SAFETY-RELATED COMPONENTS

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1.0 BACKGROUND

In the past decade, the American economy has done exceptionally well, largely because of increased worker productivity. This increased worker productivity is mainly due to the computer and communication revolution that has enabled increased efficiencies in both the service and the manufacturing industries. Personal computers and the networks that bind them have automated many formerly tedious processes, improved operating efficiencies, and facilitated innumerable business processes. But for many Americans, specifically, operators of those mobile offices known as commercial vehicles, computer automation has taken longer to achieve mainstream acceptance and adoption into their work environments. Although numerous computer systems are simplifying the lives of carriers and administrators alike, few of these systems *communicate* with each other via the common operating standards and open systems network architectures that are the hallmarks of most major industries. While some trucking companies, such as the United Parcel Service, are spearheading the implementation of new technologies when doing so clearly makes business sense, these internal systems are non-integrated *islands* of technology.

The work that has been underway for several years to apply Intelligent Transportation Systems (ITS) to Commercial Vehicle Operations (CVO) has taken a major step forward, primarily through two major initiatives sponsored by the Federal Highway Administration (FHWA). First is the establishment of the mainstream program that is concerned with the organization and the management of ITS/CVO deployment. The second major initiative is the model development and prototype deployment of ITS technologies under the Commercial Vehicle Information Systems and Networks (CVISN) program. Through these two initiatives, the FHWA is investing in the technical and organizational infrastructure that is necessary to support widespread ITS/CVO technology deployment.

1.1 THE NATIONAL ITS/CVO PROGRAM

ITS involves the application of advanced and emerging technologies in fields such as information processing, communications, control, and electronics to surface transportation needs. ITS is being applied to CVO to streamline the administration of motor carrier regulations, focus safety enforcement on high-risk carriers, reduce congestion costs for motor carriers and other vehicles, and reduce environmental damage. ITS/CVO products and services involve automating existing processes and operations, networking existing information systems, and changing the way that states and motor carriers do business.

The national ITS/CVO program comprises numerous initiatives covering multiple functions. These initiatives represent the efforts of the Federal government, individual states, consortia of states, individual carriers, and industry associations. The program is developing capabilities mainly in four broad areas:

- **Safety assurance**: Programs and services designed to assure the roadside safety of commercial drivers, vehicles, and cargo. These include manual and automated roadside safety inspections, carrier, vehicle, and driver safety reviews, safety information exchange systems, and onboard safety monitoring.

- **Credentials administration**: Programs and services designed to improve and automate the desk-side procedures and systems for managing motor carrier registrations, fuel taxes, and other credentials. These include electronic application processing, automated purchasing, and issuance of credentials, as well as automated reporting and filing of appropriate taxes.

- **Electronic screening**: Programs and services designed to facilitate the automated verification of size, weight, and credentials information. These include automated vehicle screening at weigh/inspection facilities and international borders.

- **Carrier operations**: Programs and services designed to reduce congestion and manage the flow of commercial vehicle traffic. The public sector role in this area is focusing on hazardous materials incident response services and travel advisory services. The private sector is leading the deployment of fleet and vehicle management technologies that improve motor carrier safety and productivity. For example, the use of onboard safety monitoring system and transponders would allow some vehicles and drivers to bypass weigh and inspection facilities at mainline speeds. This would result in improved highway safety and the efficient movement of commercial vehicles.

The ITS/CVO program already has made great progress. Key technologies such as weigh-in-motion, electronic data interchange, and mobile communications have been successfully developed, deployed, and tested. States and carriers are participating in operational tests and deployments using these and other technologies to screen vehicles at weigh stations and international border crossings, to enforce out-of-service orders issued as a result of driver or vehicle safety inspections, and to create regional electronic *one-stop shopping* systems. Working with the states, the FHWA has deployed portable computers and inspection software at several roadside inspection sites. In addition, all states have joined the national agreements to administer interstate vehicle registration and fuel tax collections.

The CVISN program is one of the ITS initiatives that will enhance and facilitate CVO by automating and simplifying the user services. CVISN is an integration of information systems and networks designed to improve the performance of CVO and add strategic value to the industry. CVISN includes information systems owned and operated by state and federal governments, commercial motor carriers, and other stakeholders. Maryland and Virginia are the CVISN prototype states. Also, eight pilot states are implementing the CVISN program. The purpose of the prototype/pilot program is to demonstrate the operational feasibility, efficiency, and effectiveness of CVISN concepts and systems.

1.2 INTRODUCTION

Maryland Department of Transportation (MDOT) and FHWA are currently deploying, testing, and evaluating ITS technologies to enhance the safety and efficiency of interstate and intrastate CVO. The CVISN program envisions the development, design, and deployment of various technical devices and systems to benefit interstate and intrastate commercial motor carriers and the state and federal government agencies that deal with CVO. CVISN system deployments are expected to necessitate, and otherwise facilitate, changes in the operational processes of the participants. One of the major goals of CVISN is to create *transparent* borders for interstate and intrastate commercial vehicles and improve the safety and efficiency of CVO. To achieve this objective, one of the primary requirements is to establish a national CVO system that can perform numerous user services, including automated roadside safety inspections, electronic roadside screening and clearance, onboard safety monitoring, and electronic credential and tax administrative procedures.

The purpose of this paper is to document the evaluation study and provide a report on the current implementation results of CVISN components for safety information exchange and roadside operations that will enable policy makers and commercial vehicle administrators to objectively assess the outcomes of the CVISN implementations. However, some of the safety components of CVISN are not yet operational. Hence, this document also identifies and projects the future benefits and implications of future implementation of other CVISN safety components. Safety information exchange includes distribution of safety information to and from computers at the roadside and transmission of safety data to and from other states participating in the CVISN program. Roadside operations include electronic collection of inspection data and electronic screening and clearance at both fixed and mobile sites.

Essentially, CVISN is an attempt to link the disparate ITS technologies already affecting the CVO under a single operating umbrella. Without such a link or network, these ITS computer systems would continue to operate in a stand-alone capacity and would be unable to communicate with each other in a meaningful manner.

Maryland, one of the two CVISN prototype states, is implementing the CVISN architecture to enhance and support administrative processes for CVO, improve roadside safety inspection operations, and implement electronic screening for commercial vehicles. It is anticipated that the deployment of CVISN will achieve measurable improvements in efficiency and effectiveness for commercial motor carriers, drivers, governments, and other CVO stakeholders. Some of the major advantages of CVISN are as follows:

- The CVISN architecture will enable electronic information exchange among authorized stakeholders via open standards;

- CVISN information technology will support and improve the practices and procedures for obtaining CVO permits, credentials, and the payment of fees and taxes;

- Roadside operations will focus on eliminating unsafe and illegal operations by commercial motor carriers, vehicles, and drivers without hindrance to the productivity and efficiency of safe, legal, and compliant commercial motor carriers, vehicles, and drivers.

The proposed study documents the safety benefits in terms of the efficiency and effectiveness of Maryland's Roadside Enforcement Program due to the implementation of CVISN-related computer and communications systems used to collect and distribute safety-related data. This study investigates the following safety-related activities:

- Electronic collection of inspection data at roadside inspection facilities;
- Transmission of inspection data from roadside inspection facilities;
- Distribution of safety information to computers at the roadside.

1.3 SAFETY BENEFITS OF CVISN

Implementation of CVISN will result in enhanced safety for drivers and commercial motor vehicles and all vehicles in general. Additionally, there will be improved operating efficiencies and thus considerable savings in terms of time and money for both government agencies and commercial motor carriers. As a result, both the public and private sector participants will benefit from enhanced safety and will realize savings in time, resources, and the cost of doing business. The benefits due to increased safety, efficiency, and savings are identified as follows:

1.3.1 Safety

- Reduced congestion at weigh stations will result in shorter lines of trucks waiting for clearance;

- Law enforcement will be able to concentrate its efforts on high-risk and new carriers and operators;

- Fewer trucks pulling in and out of weigh stations reduce accident risk for motor carriers and passenger vehicles.

1.3.2 Efficiencies

- Simplified, automated screening and targeting of high-risk carriers and operators will improve enforcement efficiency;

- Standardized data exchange protocols will result in a simpler and more efficient workday for motor carriers, drivers, and regulators alike;

- Low-risk carriers and drivers will face fewer, simpler, and more efficient roadside inspections;

- Commercial motor carriers will be able to file applications efficiently from their offices;

- Commercial motor carriers will be able to get better and necessary information quickly from regulatory and enforcement agencies.

1.3.3 Savings

- Electronic screening will eliminate the need for safe, legal, and compliant commercial motor vehicles and drivers to stop for unnecessary weight and safety inspection;

- Automated reporting and record keeping will reduce costly paperwork for government and commercial motor carriers;

- Commercial motor carriers will not have to go in person to file applications at each of the applicable state and federal government agencies that regulate their business;

- State and federal credentials processing government agencies will be able to process license and certificate applications more quickly and accurately;

- Electronic screening will reduce the number of stops and starts commercial vehicles must make, thus reducing fuel consumption and time idling in lines at weigh stations;

- As vehicles keep moving, the flow of goods from manufacturer to distributor to consumer will be streamlined, and on-time deliveries will increase;

- New technologies are less expensive to install and use than constructing new weigh stations. They can also improve the efficiency of existing facilities in a more cost-effective manner;

- Existing highway infrastructure and facilities can be used more effectively;

- In an era of shrinking budgets, electronic screening technologies will enable state and federal government agencies to shift personnel and resources from processing paperwork to other more important tasks;

- States will be able to collect taxes and other revenues more effectively.

In the following sections we describe in detail the safety-related components of CVISN systems and processes.

1.4 SAFETY INFORMATION EXCHANGE

Safety Information Exchange (SIE) is a process in which safety information related to carriers (their credentials, safety ratings, and other historical information), vehicles, and drivers (for both, inspection and citation records and other historical information) are collected, stored, and exchanged. The major objectives of SIE are as follows:

- Improving safety performance on roads and highways;

- Using government resources more efficiently and effectively by assisting the enforcement agencies to focus on high-risk carriers, vehicles, and drivers;

- Providing motor carriers access to better and more timely information to facilitate improved management of their safety programs.

Based on the above objectives, the major functions of the SIE program are identified as follows:

- Automated and/or electronic collection of credential data from state and federal agencies and safety-related data from enforcement agencies and concerned government agencies at the local, state, and national levels;

- Providing improved and online access to commercial motor carrier, vehicle, and driver credentials and safety information to all the stakeholders;

- Providing facility to proactively update commercial motor carrier, vehicle, and driver credentials and safety information.

1.4.1 SAFER

Safety and Fitness Electronic Record (SAFER) is an online, nationwide system developed by the Johns Hopkins University Applied Physics Laboratory, under contract to the FHWA. The primary objective of SAFER is to facilitate the exchange of carrier, vehicle, and driver safety and credential information among different jurisdictions nationwide. SAFER provides authorized users access to only interstate carrier, vehicle, and driver safety and credential information. Authorized users input inspection data at fixed and roving sites and other state and federal credentials processing agencies. All stakeholders can access the inspection data. Based on the information provided by SAFER, the roadside inspectors will be able to perform their tasks in a more effective and efficient manner. For example, roadside inspectors will be able to screen and select vehicles and/or drivers for inspection based on the number and results of prior carrier inspections, as well as historical information about the carrier, vehicle, and driver safety and credential records. In addition to the advantages for law enforcement agencies, SAFER also benefits the motor carriers by eliminating duplicate inspections in multiple jurisdictions. Hence, by being able to identify non-compliant and unsafe drivers, the enforcement agencies will be able to concentrate their efforts and resources on these operators, thus improving highway safety and rewarding safe, legal, and compliant commercial motor carriers whose vehicles and drivers will be subject to fewer inspections.

SAFER provides two types of standardized carrier, vehicle, and driver data sets: snapshots and reports. Snapshots contain limited but critical information such as identifying information, status flags, and key data items (for example, census data, compliance review summary, inspection and accident data summary, and OOS history).

Reports contain more detail information than snapshots and are based on criteria that are pre-defined by the user. Snapshots are primarily designed to support electronic roadside clearance and are used when time is a critical factor for obtaining information. In contrast, reports are used when snapshots do not provide all the information and the timeliness of responses to queries is less critical. Snapshot data are stored in the system to facilitate quick response, while data used in reports are not stored permanently. SAFER provides snapshots and reports to users based on user-defined subscription criteria. EDI X12 transaction set 285 is used to carry snapshot information, whereas EDI X12 transaction set 284 is used to carry safety report information.

SAFER also provides access to information concerning a motor carrier's safety fitness rating, roadside inspection history, and accident record via the Internet at www.safersys.org. In addition to the safety rating score obtained using the Inspection Selection System (ISS), SAFER also provides out of service (OOS) inspection. All the information displayed using the Internet query is public information and has been available under the Freedom of Information Act at no cost. The system allows motor carriers information that was formerly obtained via telephone requests and hard copy paper reports to be transferred electronically. A major benefit of such an approach is the ability to access that information using several different methods. The ability to query interstate carriers is available through the SAFER web site. Queries can be made on the SAFER database using the carrier's DOT number, ICC number, or name. Additionally, the SAFER homepage provides links to other related sites, including FHWA's home page and the SAFER Deployment Coordinator.

SAFER is heavily subsidized by FHWA, and information on SAFER is currently provided at no cost. SAFER will continue to provide information at no cost to certain types of users, including enforcement agencies and other state and federal agencies that provide it with credential and safety information. However, other users will be required to pay a nominal fee ($9 per profile request) for their data exchange activities. These fees will be used to offset the cost of maintaining the SAFER database. SAFER costs are mainly of three types: infrastructure costs that include cost of hardware, facilities, personnel, and supplies; data costs paid to Motor Carrier Management Information System (MCMIS) for providing SAFER with motor carrier credential and safety information; and telecommunications costs for sending information to its users.

An inspection report consists of all the census and safety information collected at the roadside during a vehicle and/or driver inspection. These inspection reports are formatted according to the input definition defined in the *SAFER and CVIEW Application Programming Interface (SCAPI) Inspection Report Field Definitions Document*, published by the Johns Hopkins University Applied Physics Laboratory, and are uploaded and stored in the SAFER system for 45 days. Inspectors from all jurisdictions have access to these inspection reports during the 45-day retention period, after which they are purged from the system. SAFER sends these reports to the requester in the same format as defined in the *SCAPI Inspection Report Field Definitions Document.*

As an interstate system SAFER, has certain limitations. For example, it cannot provide safety information regarding intrastate carriers, vehicles, and drivers. As a result, the CVISN architecture has proposed the implementation of a new system called Commercial Vehicle Information Exchange Window (CVIEW) as a key element of each state's CVISN design.

1.4.2 MCMIS

Before the design and implementation of CVISN, MCMIS served as the primary repository for credentials and safety-related data on interstate commercial motor carriers, vehicles, and drivers. MCMIS was established by FHWA's Office of Motor Carriers (OMC) to store, track, and analyze census information about interstate commercial motor carriers and hazardous material shippers. MCMIS receives credential and safety information on all interstate motor carriers, vehicles, and drivers from SAFETYNET systems of different states. This information is then uploaded on a regular basis to the SAFER system for distribution to all jurisdictions in all states. In the past, those who requested motor carrier safety information contained in MCMIS had to pay a service fee of about $25 per request. This was used by FHWA to cover the cost of preparing the

Carrier Profile Report and mailing it or transmitting it to the requester by facsimile. However, since SAFER will provide electronic access to this information, there will be a significant reduction in cost per request (currently information is provided at no cost). Additionally, the requester will be able to receive this information in a much-improved and timely fashion.

1.4.3 CVIEW

Commercial Vehicle Information Exchange Window (CVIEW) is a system administered by each state to manage *segments* of snapshots for interstate carriers, vehicles, and drivers based in that state and to manage *whole* snapshots and reports for all intrastate carriers, vehicles, and drivers in that state. In other words, CVIEW is a derivative of the SAFER system and can be viewed as a state-owned and -operated version of the nationwide SAFER system. It is designed to handle information on both interstate and intrastate carriers, vehicles, and drivers who operate in the state. The key motivation for developing CVIEW as a separate entity from SAFER is to provide states with a single point of access to its intrastate safety and credential information and to provide SAFER with a single source of information about the interstate carriers, vehicles, and drivers in the state. With this design SAFER is relieved of the burden of having to establish a custom interface to each state's legacy systems. Hence, each state will be able to exchange interstate information via the SAFER system. CVIEW is currently being deployed and implemented as part of the CVISN prototype project in the states of Maryland and Virginia. CVIEW will have the ability to distinguish between intrastate and interstate operators. Data, snapshots, and reports of interstate carriers, vehicles, and drivers operating in the state are forwarded to SAFER to provide access to other jurisdictions in other states, while information regarding intrastate carriers, vehicles, and drivers is stored locally. SAFER then sends updated snapshots to all subscribers, i.e. to the state's CVIEW. CVIEW in turn forwards the updated snapshots to all roadside sites and ASPEN host computers that subscribe to it within the state. The Roadside Operations System that receives the updated snapshot will forward the snapshot to all Roadside Operations Computer (ROC) systems for use by inspectors to screen commercial motor vehicles and drivers.

1.4.4 SAFETYNET

Before the implementation of CVISN, all manual and electronic inspection reports were uploaded to the state's SAFETYNET system. The AVALANCHE software converts the data obtained from inspection reports created with ASPEN software to the appropriate format for upload to SAFETYNET. SAFETYNET will then store the inspection reports of intrastate commercial motor carriers, vehicles, and drivers locally, while transmitting the data on interstate operators and vehicles to FHWA's MCMIS for distribution to all jurisdictions. As mentioned earlier, MCMIS also makes this information available to all other stakeholders by providing carrier profile reports to all other stakeholders for a fee. SAFETYNET also has the capability to obtain information on interstate commercial motor carriers, vehicles, and drivers operating in other states from SAFER.

1.4.5 ROC

Roadside Operations Computer (ROC) systems are located at weigh/inspection facilities and assist the enforcement agency in performing efficient and effective inspections of vehicles. ROC systems have the ability to download credential and safety snapshots of commercial motor carriers, vehicles, and drivers from CVIEW and SAFER. These snapshots would also include the *safety index* (based on ISS) of the carrier. Using ROC, a user would be able to send criteria for screening a vehicle to the screening computer. The screening computer would in turn read data from the vehicle's transponder unit and the weigh-in-motion (WIM) scales and forward them to the ROC user. Based on the screening results, the ROC user would signal the vehicle to bypass the weigh/inspection facility or come in for additional inspection.

Additionally, ROC has the capability to upload inspection data directly to CVIEW, which would then forward the results of inspections on interstate commercial carriers, vehicles, and drivers to SAFER for distribution to other jurisdictions and locally store the information on intrastate operators and vehicles.

1.4.6 ASPEN

ASPEN, a windows-based software selected by most of the states, was developed by the FHWA's OMC and is provided by the FHWA to different states. It has the ability to provide more timely and accurate data as compared to the method used by the states in which the state employees are required to re-enter handwritten inspection reports into the system days, weeks, or even months after the inspection. ASPEN also has the ability to assist the inspector in selecting the commercial vehicle for inspection based on the information already available in the system. It also has an interface for distributing citations, accident reports, and compliance review reports electronically to the state's CVIEW and FHWA's SAFER.

The department responsible for collecting and disseminating inspection data in the State of Maryland is the Maryland State Police, Commercial Vehicle Enforcement Division (MSP-C.V.E.D.). Upon completing an inspection (ASPEN-based or manually filled inspection reports) at either roadside weigh and inspection facility, the inspection reports are forwarded to the C.V.E.D. office for uploading to SAFETYNET and the state's CVIEW. The electronic roadside inspection process using laptop or desktop computers using ASPEN software in the state of Maryland is as follows:

- The inspection reports are entered at roadside inspection facilities using laptop or desktop computers using the ASPEN software.

- When completed, inspection reports are uploaded to Maryland's mailbox on the SAFER system.

- The AVALANCHE software at C.V.E.D. Headquarters downloads the information from the SAFER mailbox and makes it available to the SAFETYNET software for uploading to MCMIS.

ASPEN also has the ability to download snapshots from CVIEW and SAFER. The snapshots could be used at both fixed inspection stations and at roving enforcement vehicles equipped with laptop computers. Future versions of ASPEN software are anticipated to support direct links to CVIEW. In this case, Blizzard 32 will replace the AVALANCHE Bulletin Board System in SAFETYNET for transforming ASPEN database tables into SAFETYNET required database tables. Before CVISN, inspection reports of interstate carriers from state SAFETYNET systems were uploaded to FHWA's Motor Carrier Management Information System (MCMIS). Under the CVISN program, snapshots are also uploaded from MCMIS and CVIEW to SAFER.

The ASPEN software also includes a program called Past Information Queries (PIQ) that assists an inspector to query the SAFER database using the carriers' DOT number, ICC number, or state ID. The inspector will then have access to detailed reports on all the inspections performed on that vehicle and/or driver in the preceding 45 days. Based on the information provided in these reports, the inspector will be able to make a determination if a particular vehicle is operating safely and legally. Considering the costs of communications and the advantages of providing information on inspections as quickly as possible, most enforcement agencies recommend that inspection reports be uploaded to SAFER twice a day. The goal is to ensure that a given inspection report is at the most four hours old before it is available through the SAFER system. However, there is an exception to this rule when a vehicle is put on OOS status. In this case, it is recommended that the OOS report be posted in the SAFER database immediately and be available to other officers and jurisdictions for OOS violation enforcement activities. The aim is to have an OOS inspection report available for enforcement activities within ten minutes of the completion of an OOS inspection.

To further accelerate the safety data exchange process, road inspection data are transmitted from ASPEN to the SAFER data mail box, which helps in distributing safety data to be used in other states.

1.4.7 Links

Figure 1 shows the links between the different components of the Safety Information Exchange system that facilitates the communication between these systems. These links are as follows:

ASPEN - SAFER (Mailbox) LINK

ASPEN - SAFETYNET (Avalanche) LINK

SAFETYNET- MCMIS LINK

MCMIS - SAFER LINK

SAFER- ROADSIDE LINK

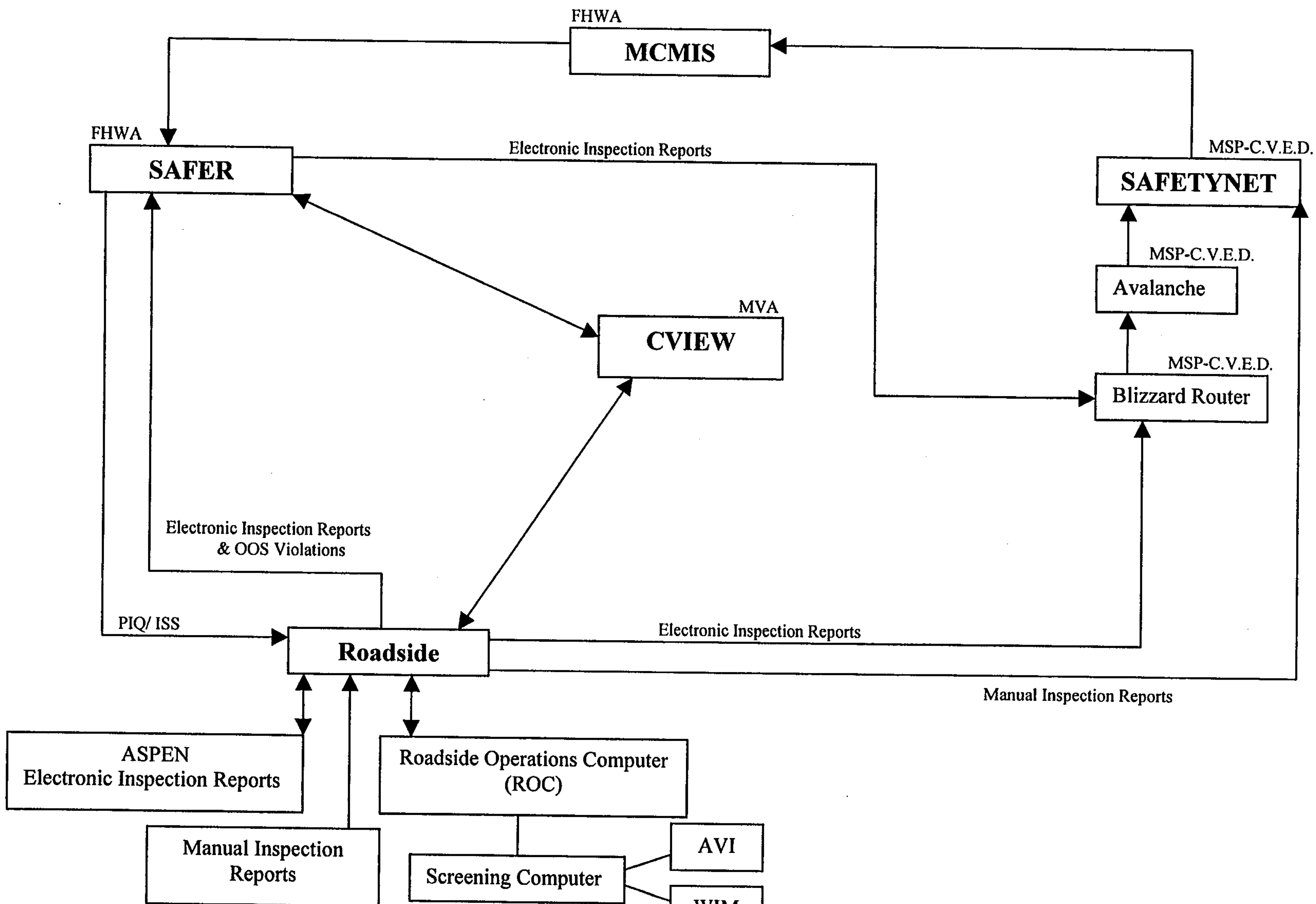
CVIEW - ROADSIDE LINK

CVIEW - SAFER LINK

ASPEN- SAFER (Mailbox) LINK

The detailed processes are discussed in the following section.

Figure 1: Maryland Commercial Vehicle Operations: Safety Information Exchange Roadside Safety-Related Components and Links.



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2.0 INSPECTION INFORMATION PROCESSING

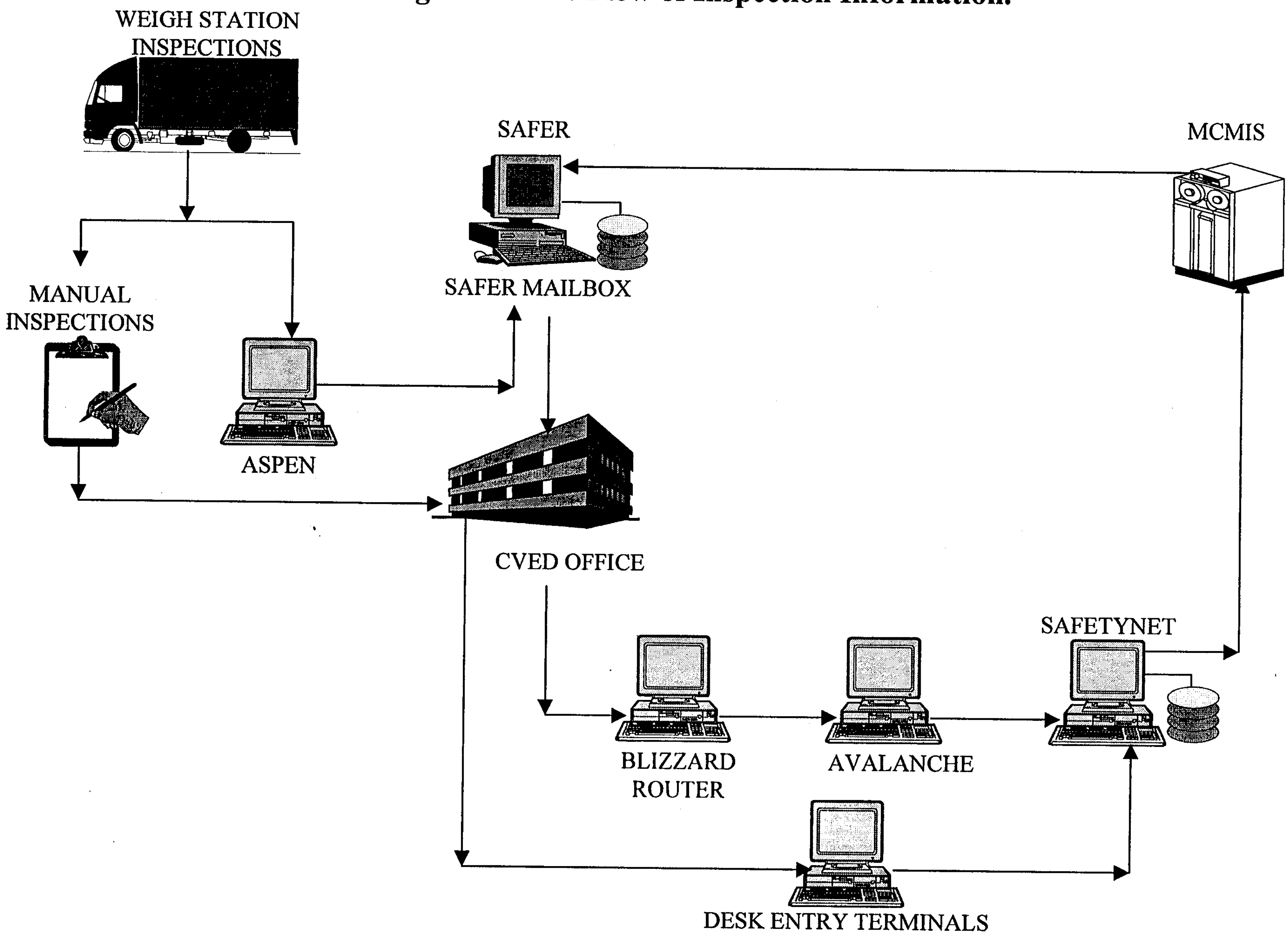
This section describes the flow of inspection data in Maryland (Figure 2). Inspections of commercial motor vehicles and motor coaches are conducted at 72 locations. A majority of the inspections are carried out at fixed locations throughout the state. The inspection process at a representative fixed site (West Friendship Weigh & Inspection Facility) is described in a separate document entitled "Safety Inspections of Commercial Vehicles at Maryland Weigh/Inspection Facilities." Inspection data entered manually are mailed to the C.V.E.D. headquarters. The processing of these data is described in Section 2.1. Inspections entered electronically are uploaded to the SAFER system by the inspector. Section 2.2 describes the processing of these electronic data at the C.V.E.D. office. Finally, the inspection information is uploaded to the Motor Carrier Management Information System (MCMIS). Section 2.2.3 describes the upload processes.

2.1 INSPECTION PROCESS

This section describes the inspection process at the West Friendship Weigh & Inspection Facility, located on Westbound Interstate 70 (I-70) in Howard County, just west of Maryland Route 32 (MD 32). The main functions of the scale house are to weigh and inspect vehicles over 10,000 pounds.

Drivers of vehicles over 10,000 pounds that travel west on route I-70 are notified by a road sign to pull into the West Friendship weigh facility to have their vehicles weighed and inspected. Upon entrance, there are two lanes a vehicle can travel. Lane one is for weighing vehicles and lane two is to allow vehicles to bypass the scale. A signal is positioned on the entrance ramp to notify drivers of the lane to travel. If a vehicle is signaled to go through the bypass lane, it is not weighed and the driver is allowed to continue on to his or her destination. For safety considerations, vehicles are allowed to bypass the scale at times of heavy traffic on the highway. When a vehicle is signaled to enter the scale lane, the vehicle is weighed and visually inspected. At that point there are

Figure 2: The Flow of Inspection Information.



several variables that determine whether a driver will be requested to pull into the inspection area to receive a possible Level I, II, III, or IV inspection, or (if applicable) to receive a traffic citation for a weight violation. These variables fall into one of three categories:

- Overweight violations
- Visual violations
- Random selection

A vehicle can fall into the overweight violation category if the vehicle exceeds allowable weight limits as mentioned earlier. If a vehicle violates any of these specifications, it is subject to a traffic citation and fine.

Visual violations are identified at the point when a vehicle is on the scale being weighed. The inspectors follow established guidelines as defined in both federal and state regulations that pertain to the weighing and measurement of vehicles. In most cases, the inspector relies on visual observation of the vehicle. Violations that are noted include missing IFTA decals, damaged/bald tires, cracked windshield, obvious equipment violations, improperly secured cargo, and other sundry violations. These visible violations are grounds for a vehicle to undergo closer inspection, which can be either a Level I, II, III, or IV inspection.

The final category that can cause a vehicle to be subject to a Level I, II, III, or IV inspection is random selection. In this instance, there are no definite criteria that are utilized in the selection process; selection is purely random.

The inspection process can be conducted either manually or electronically through the ASPEN system. The roadside inspection processes for manual and electronic inspections are as follows.

Manual inspections are conducted using MSP Form #24-32, which is filled out by the inspector. After the inspector fills out the inspection report, it is manually checked before the reports are sent to MSP-C.V.E.D. for processing in SAFETYNET.

The electronic inspection reports are entered at roadside workstations or laptops using the ASPEN software. Inspectors use the ASPEN software to enter the DOT number or the ICC number. This information is used by the Inspection Selection System (ISS) to retrieve the carrier information. The carrier information provides a fitness value of the carrier along with demographic data for the carrier. Next, the "Driver" tab and the "Vehicle" tab details are filled in, and violations, if any, are checked. The "State" tab details are then filled. Finally, the inspections may be sent to SAFER or saved. A printed copy of the inspection report is given to the driver. The software does not allow the inspection process to be completed unless all mandatory fields are entered. The inspectors are recommended to post inspections that result in out of service status immediately to SAFER.

During the inspection process, the inspector may find it valuable to use the ISS system in greater detail. The ISS system provides a comprehensive history of the carrier and other details such as the vehicle out-of-service rate, driver out-of-service rate, safety fitness rating, inspections per power unit, inspections per driver, and total number of inspections. This information is updated weekly. Additional details on violations can also be accessed using ISS. The software highlights all potential problems with the carrier, making the inspection process easier for the inspector. If up-to-date information is required, the inspector can request an individual update through the SAFER system. The inspector may also use the Past Inspection Query (PIQ) to obtain detailed vehicle inspection information during the previous 45 days.

At the end of the day/next day, the inspection reports are uploaded to SAFER. The data entry supervisor at the C.V.E.D. office retrieves the inspection reports from SAFER via the AVALANCE Blizzard router, which polls SAFER on an hourly basis.

2.2 INSPECTION INFORMATION PROCESSES AT MSP-C.V.E.D. HEADQUARTERS

All inspection data for inspections conducted in the state of Maryland are processed in the C.V.E.D. office. The processing of manual inspection reports, electronic inspection data, and upload of inspection information to MCMIS is described in this section.

2.2.1. Manual Inspection Reports Processing

Manual inspections from throughout the state are sent to C.V.E.D. The manual inspection forms that are sent to the C.V.E.D. office are normally from authorities who do not have direct connection to SAFER and from those inspection authorities that carry out limited inspections, such as county police departments. The total number of manual inspections conducted varies from department to department, depending on their facilities and resources. Even the facilities that are equipped with the ASPEN-based computer systems conduct manual inspections due to resource constraints.

The inspection forms received by the C.V.E.D. office are first arranged by their printed sequence numbers. The C.V.E.D. office has three computers through which the manual inspection reports are entered. Currently, two full-time and one half-time data entry personnel enter the inspection reports to the computer. During the process of entering the manual inspection data into SAFETYNET, two different modes are used. These are the interactive mode and the batch mode.

The interactive mode is the most commonly used mode to enter the manual inspection data. The US DOT number or the ICC number is entered for the carrier, which results in other carrier information being displayed on the screen, thus making it easy for the data entering personnel to validate the data. This also helps in verifying the information on the inspection form. This mode is mostly used for inspections done on interstate carriers.

The batch mode is used for intrastate carriers and for those carriers that are new in the system or those that have converted from intrastate to interstate. This mode is rarely used.

The data entry personnel enter the inspection data to the system. Incomplete forms or forms that have errors are kept aside and are dealt with at the end of the data entering process. Some common types of errors on the inspection forms are missing, incorrect, or misplaced information. The following are some of the most commonly occurring problems or errors in the inspection forms: incorrect or missing US DOT number, incorrect or missing ICC number, incorrect or missing carrier address/name, missing or incorrect information regarding interstate or intrastate status, incorrect driver license number, incorrect VIN number, and incorrect violation code number.

The incomplete inspection forms are then checked on the basis of other information provided in the forms. Missing information can be obtained by calling the respective authorities to recheck their records or by sending the inspection forms back to the weigh station to the officer incharge of the inspection. Other sources of information include the Criminal Justice Information System (CJIS), which is used to get driver information.

Incomplete manual inspection forms are often corrected in the C.V.E.D. office. The rate of returning these forms back to the weigh stations is less than 1%; this only happens when vital information is missing from the inspection forms.

2.2.2 Electronic Inspection Reports Processing

Inspection reports entered through the ASPEN system at the weigh stations are uploaded to SAFER periodically. At the C.V.E.D. office, these inspection reports are downloaded by means of automatic polling every hour through a dedicated router (Blizzard). These data are then saved onto a diskette on a daily basis. The AVALANCHE software is used to unzip the inspection reports and convert the SAFER data format into a dBASE IV (dbf) data format that is SAFETYNET compliant. The dbf-formatted data are uploaded to SAFETYNET and subsequently sent to the Motor Carrier Management Information System (MCMIS).

ASPEN as well as manual-based inspection reports can have two types of errors: data entry errors and inconsistency of data between Maryland's systems and Federal Highway Administration's systems. The latter errors will henceforth be referred to as non-match errors. Data entry errors are identified in the process of uploading the data to the SAFETYNET system. When the inspection reports get to SAFETYNET, there are several basic checks performed before the inspection reports are uploaded to MCMIS. These checks do not involve verification of information but ensure that a given field contains characters or numbers and the data type as specified in the field description. SAFETYNET performs a check querying several individual database files.

Several of the errors are corrected automatically by the SAFETYNET program. However, not all of the errors identified as incorrect data are actually incorrect data entry errors. A few errors occur during the unzipping and the conversion process at AVALANCHE for the ASPEN inspection data. Where errors cannot be corrected, the C.V.E.D. office has to search the files, or call the inspector who conducted the inspection so the error can be corrected.

2.2.3 MCMIS Update

At the end of the day, the manual inspection reports are merged with the ASPEN data in SAFETYNET. After passing the checks performed by SAFETYNET, the inspection reports are collected in batches and periodically uploaded to MCMIS every 7-10 days. If MCMIS detects an error or inconsistency within the inspection reports received from SAFETYNET, MCMIS will upload the confirmation of errors to SAFETYNET. The error report on the non-match report from the FHWA is sent to the C.V.E.D. each month. The type of error determines what type of corrections SAFETYNET will need to perform. If the confirmation of errors received from MCMIS involves errors with the city, state, or zip code, SAFETYNET will edit the inspection report and upload the corrections to MCMIS. If the errors are located in the report number, inspection date, or start time fields, the inspection report must be re-entered into SAFETYNET with the corrections. The old inspection report is deleted, the database is loaded, and uploads are made to MCMIS. Then MCMIS will send another confirmation of receiving the deletion. After SAFETYNET receives this confirmation from MCMIS, the inspection report is re-entered correctly and uploaded to MCMIS.

Table 1 depicts the current deployment status of CVISN based on the study of the CVISN components and the processes currently in place. While the ASPEN inspection system is utilized for the inspection process, the ROC system is currently not being used to screen vehicles.

Table 1. Current Deployment Status of CVISN

Function	Without CVISN	Current Deployment Status
Deliver Safety and Credential Data to Roadside	• All manual • Call-in only • No direct access to IRP, IFTA, OS/OW, HAZMAT	• Carrier safety profiles (renewed quarterly) available on laptops and ASPEN PCs through ISS • No direct access to IFTA, OS/OW , HAZMAT • IRP - ROC subscription process has been implemented
Select Truck	• Random selection • Select from all trucks stopping at fixed site or flagged down on highway by mobile enforcement officer • Selection process depends on officer experience, staff availability, and type of facilities involved (fixed, mobile)	• Interstate trucks selected at random • Officer experience and discretion will continue to be used to screen for visible and obvious safety defects • ISS is used as a screening tool Continued

Function	Without CVISN	Current Deployment Status
Perform Inspection	• Standard inspection	• Standard inspection • Level and focus of inspection may be influenced by carrier safety profile
Record Inspection Results	• Entered directly on paper form	• Recorded in ASPEN and printed at roadside • Entered directly on paper form
Submit and Process Inspection Results	• Clerk enters data in computer for processing • Upload to MCMIS through SAFTYNET from 7 to 10 days • Confirm data upload accuracy with MCMIS	• Data uploaded to SAFER asynchronous dial-up modem to SAFER for ASPEN inspection • Confirm data upload accuracy with MCMIS • Manual inspections are entered into SAFETYNET • ASPEN inspections are electronically formatted before uploading to SAFETYNET

PART II

SAFETY ASSURANCE ANALYSIS

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3.0 ANALYSIS OF SAFETY-RELATED ACTIVITIES AND DATA

This study is designed to evaluate the current roadside inspections of commercial motor carriers, drivers, and vehicles and related processes. Based on the current deployment status of CVISN, several evaluation measures are identified. These evaluation measures deal with the inspection processes discussed in Section 2 and are as follows:

1. **Throughput:** This measures the total number of inspections conducted at roadside weigh/inspection facilities and by roving crews in Maryland. This analysis studies the trend of the number of electronic and manual inspections conducted in Maryland. Additionally, this analysis is done for all inspection Levels (I, II, III, IV, and V) and for the two major truck types: truck tractor/semi-trailer combination and straight truck. The trend of inspections at several major inspection locations is also reported in a separate document entitled "Safety Inspections of Commercial Vehicles at Maryland Weigh/Inspection Facilities."

2. **Efficiency:** This measures the time taken to conduct inspections. This analysis compares the time taken to conduct manual and electronic inspections. The time taken to conduct both types of inspections is reported for inspection Levels I, II, and III as well as for the two major vehicle types.

3. **Effectiveness:** This measures the number of violations cited at roadside weigh/inspection facilities and by roving crews in Maryland. The measures of effectiveness are the average number of violations cited per inspection and the percent of inspections that result in a violation(s). This analysis compares the average number of violations and Out-of-Service (OOS) violations per inspection for both manual and electronic inspections. For both types of inspections, this analysis also compares the percent of inspections that result in violation(s) and OOS violation(s) being cited. This analysis is reported for inspection Levels I, II, III, and V as well as for the two major truck types.

4. **Timeliness:** This measures the availability of safety inspection data to various stakeholders. For both manual and electronic inspections, this analysis compares the three major components: availability of inspection data in electronic format, availability of inspection data on SAFETYNET, and availability of inspection data on MCMIS.

For all of the above items, the analysis is based on data collected from Maryland's SAFETYNET. The database files are obtained from the MSP-C.V.E.D. office. For this analysis, data for all inspections conducted in Maryland for the period January 1998 through June 1999 are used. During this period, a total of 155,009 inspections were conducted, of which 111,226 were manual inspections and the remaining (43,783) were electronic inspections. The following database files and the corresponding fields are used:

A. INSPECT.DBF, which contains detailed data on inspections. For this analysis, the following fields are used:
   i. RPTNUM: Inspection report number. Manual inspection reports have numbers from MD00000000 through MD99999999, while electronic inspection reports have numbers from MDAA000000 through MDZZ999999.
   ii. LEVEL: Level of Inspection. As described earlier in Section 2, there are five levels of inspections.
   iii. INSPDATE: Date of inspection.
   iv. DURATION: Time taken to conduct inspection.
   v. INSPLOC: Inspection location.
   vi. FACILITY: Fixed or roving inspection facility.
   vii. TOTALVIO: Total number of violations excluding OOS violations.
   viii. TOTALOOS: Total number of OOS violations.
   ix. INPUTDATE: Date the inspection report is keyed in.
   x. INTDATE: Date the inspection data are integrated into SAFETYNET.
   xi. UPDATE: Date the inspection data are last uploaded to MCMIS.

B. VEHICLE.DBF, which contains the codes for vehicle type(s) inspected.
   i. RPTNUM: Inspection report number.
   ii. UTYPE: Code for type of vehicle unit inspected. This field is used to identify the two major truck types: truck tractor/semi trailer combination and straight truck.

C. UNITTYPE.DBF, which identifies the vehicle types corresponding to the vehicle unit codes.
   i. UTYPE: Code for type of vehicle unit inspected.
   ii. UNAME: Type of vehicle unit.

5. **User Satisfaction:** This measures how well the safety inspection systems are meeting the needs of the users in terms of product and service quality. The two principal users of the system are the inspectors conducting the roadside inspections and the drivers of commercial vehicles.

   i. **Driver Satisfaction:** A survey instrument was designed to measure the perceptions of commercial vehicle drivers about roadside commercial motor vehicle and driver inspections conducted in Maryland. The data for this survey were collected through numerous personal interviews at several truck stop facilities in Maryland. This analysis compares the manual and electronic inspections with respect to driver perceptions of objectivity and efficiency of the two inspection processes. Additionally, the analysis also compares the legibility and clarity of the manual and electronic inspection reports given to drivers after the inspection.

   ii. **Inspector Satisfaction:** This analysis summarizes the results of a focus group survey conducted by CJI Research Corporation for MSP-C.V.E.D. The analysis reports on anecdotal comments regarding the use of and satisfaction with the ASPEN system.

6. **Completeness:** This measures the completeness of the inspection reports written/entered by inspectors. Electronic inspection reports cannot be uploaded unless all mandatory fields are entered. This analysis reports on the percent of manually entered inspection reports that are incomplete.

7. **Accuracy:** This measures the accuracy of the information entered on the inspection report. This analysis compares the percentage of non-matches of data for both electronic and manual inspections.

8. **Data Upload Efficiency:** This measures the time taken by the MSP-C.V.E.D. personnel to enter and upload inspection data to SAFETYNET. This analysis compares the efficiency for uploading inspection data for both manual and electronic inspections.

3.1 THROUGHPUT

Throughput measures the total number of inspections conducted at weigh/inspection facilities and roving crews in Maryland. Figure 3 shows the total number of manual and electronic inspections for the period January 1998 through June 1999. The total number of inspections in the period varied from 7,089 to 10,853 inspections per month. The average number of inspections carried out in a month was 8,612. As seen in the figure, the number of inspections conducted electronically has been increasing steadily since the deployment and implementation of the systems. Simultaneously, the number of inspections conducted manually has decreased during this period. The figure also shows the percentage of inspections conducted electronically. As seen from the figure, the total number of electronic inspections has increased steadily from approximately 6% of the total to nearly 50%. The increase in the number of electronic inspections is the result of deployment of laptop computers and educational initiatives. This increase is in accordance with the objectives of the CVISN program.

These inspections are carried out at different levels. Figures 4 through 7 show the total number of manual and electronic inspections at Levels I, II, III, and V. As shown in Figures 4 through 6, the number of electronic inspections for Levels I, II, and III has been increasing steadily. Figure 7 shows that, for Level V, the majority of inspections are conducted electronically.

The analysis is broken down in terms of the major types of commercial vehicles: semi trailers (Figure 8) and straight trucks (Figure 9). For both the types of trucks, the number of electronic inspections has been increasing steadily; simultaneously, there has been a decrease in the number of inspections conducted manually. However, proportionately more inspections are being conducted electronically for semi trailers compared with straight trucks.

A separate document entitled "Safety Inspections of Commercial Vehicles at Maryland Weigh/Inspection Facilities" shows the number of electronic and manual inspections at each of the major inspection locations. The criterion used to define a major inspection location was that the site should have conducted 1,000 inspections in the period January 1998 through June 1999, that is, an average of 56 inspections per month.

In conclusion, the number of inspections conducted electronically is increasing steadily while the number of manual inspections reveals a corresponding decrease. Additionally, a higher fraction of semi trailers are being inspected electronically when compared to the proportion of straight trucks.

Figure 3: Total Number of Inspections (All Levels).

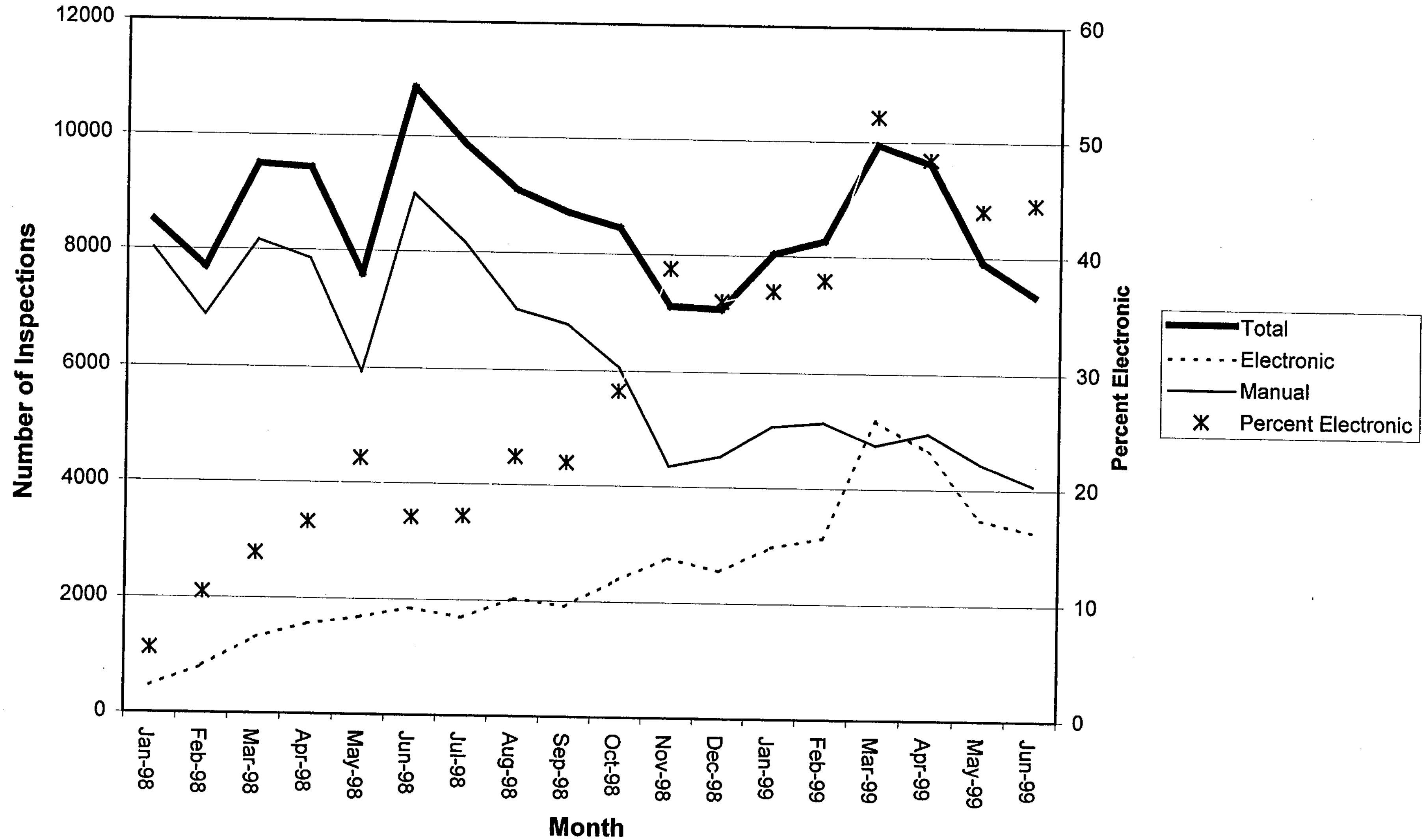


Figure 4: Total Number of Inspections (Level I).

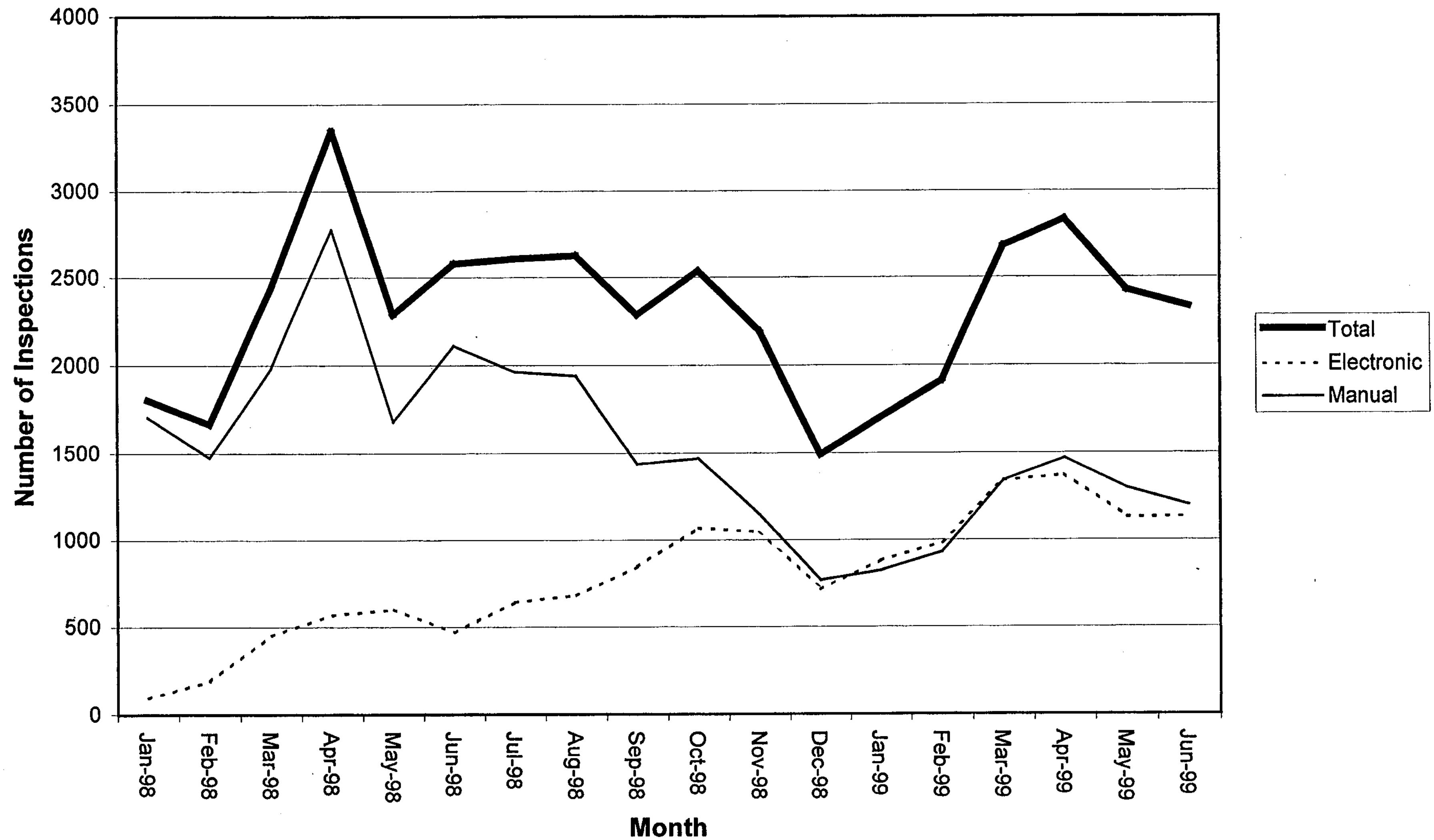


Figure 5: Total Number of Inspections (Level II).

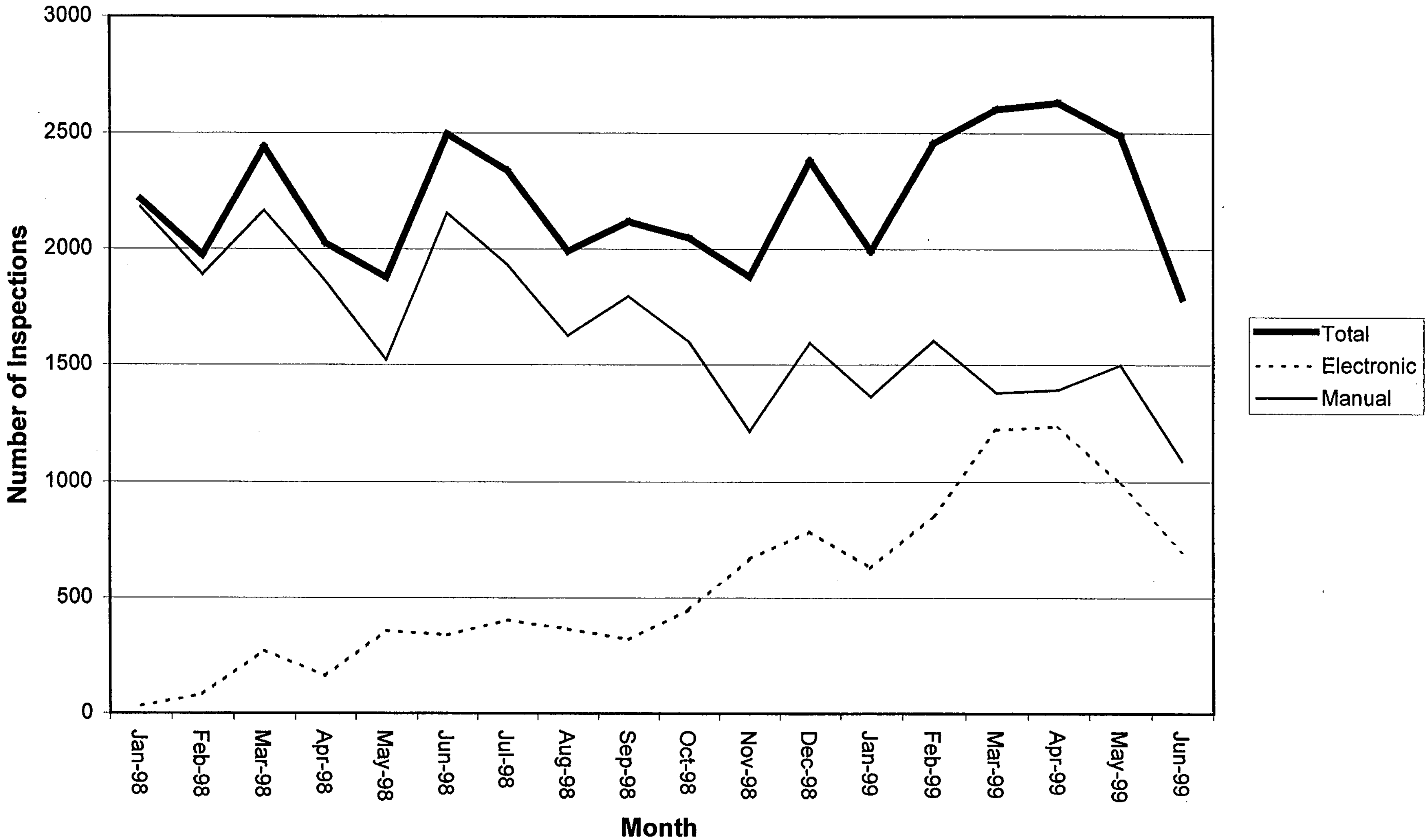


Figure 6: Total Number of Inspections (Level III).

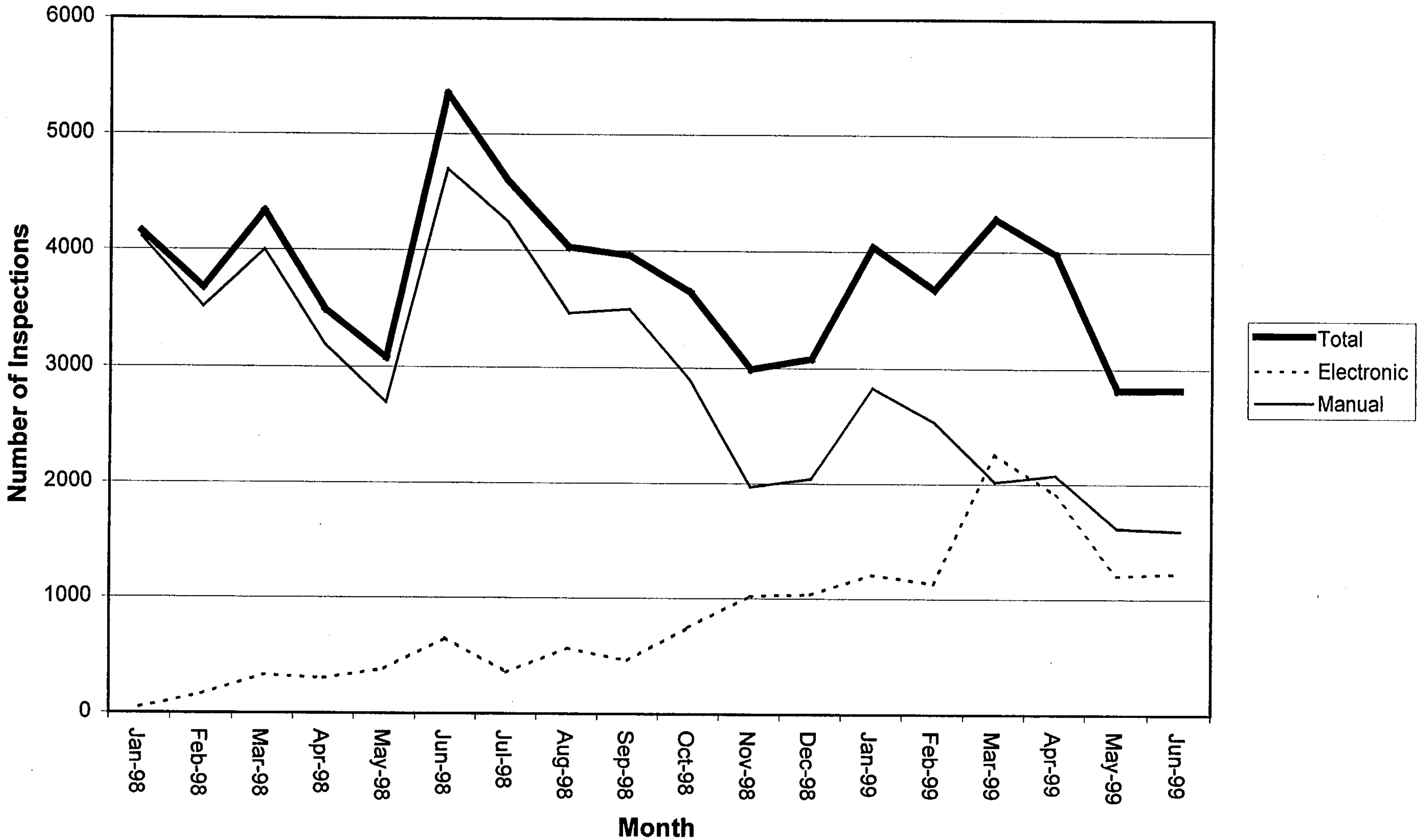


Figure 7: Total Number of Inspections (Level V).

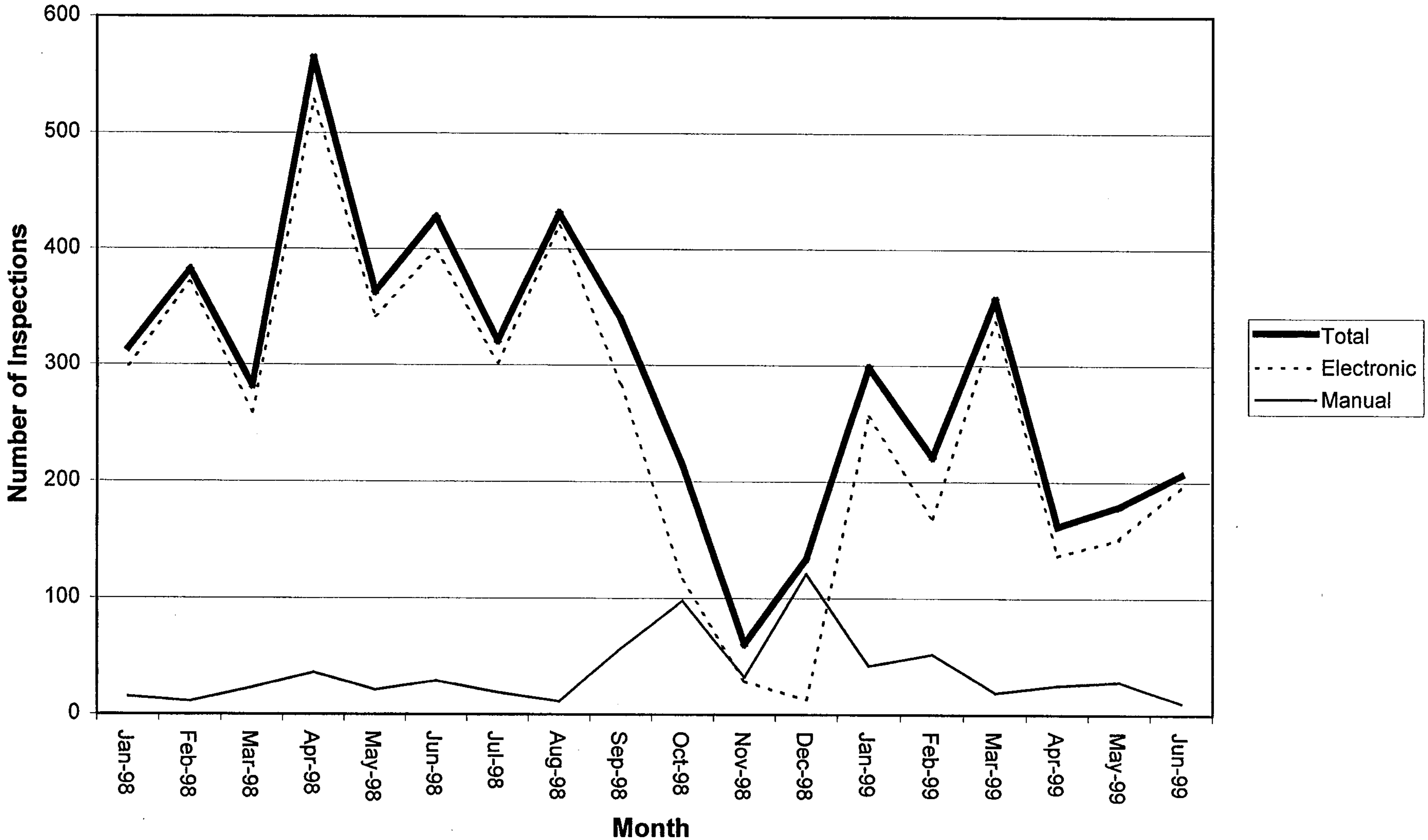


Figure 8: Number of Inspections Carried Out On Straight Truck (TR).

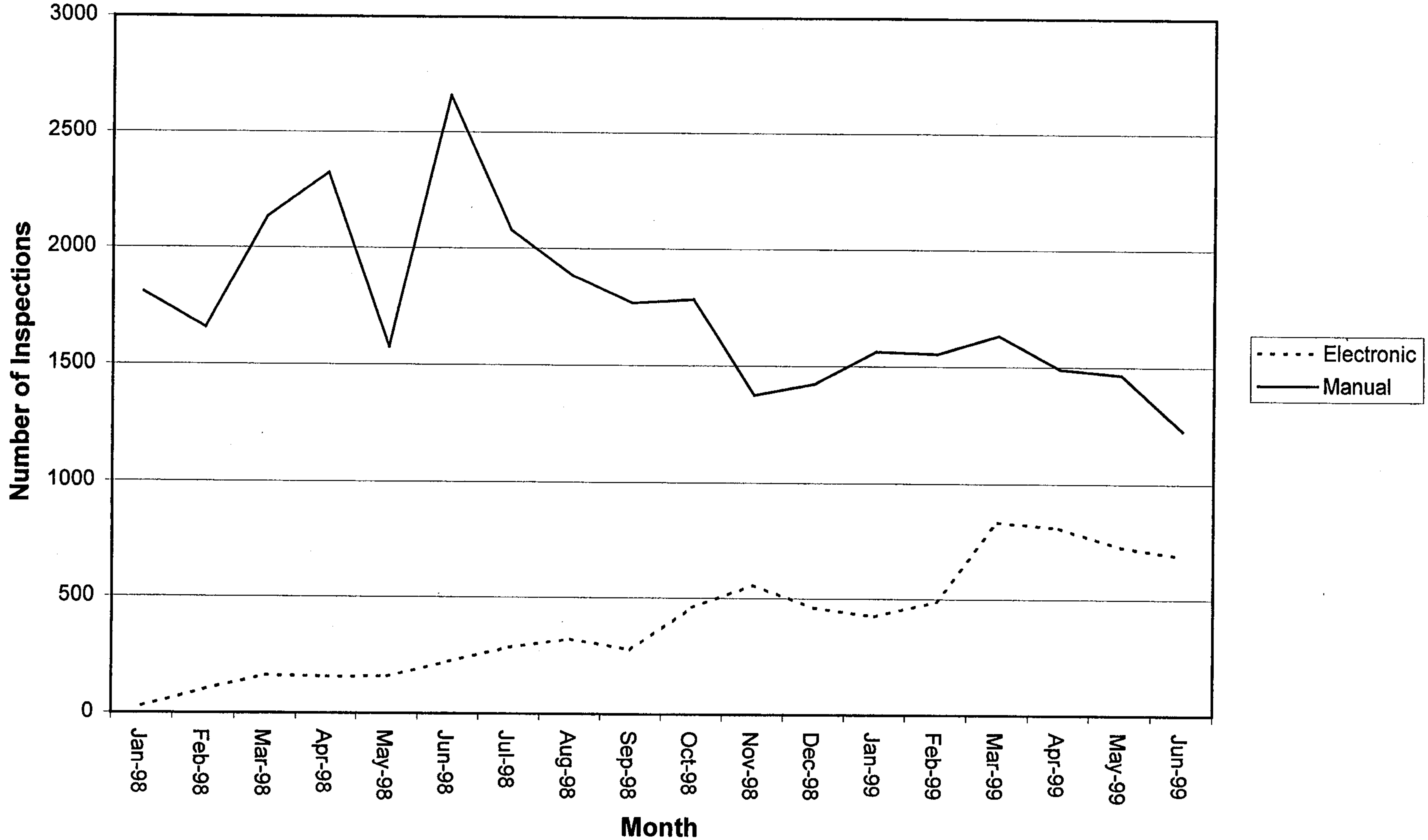
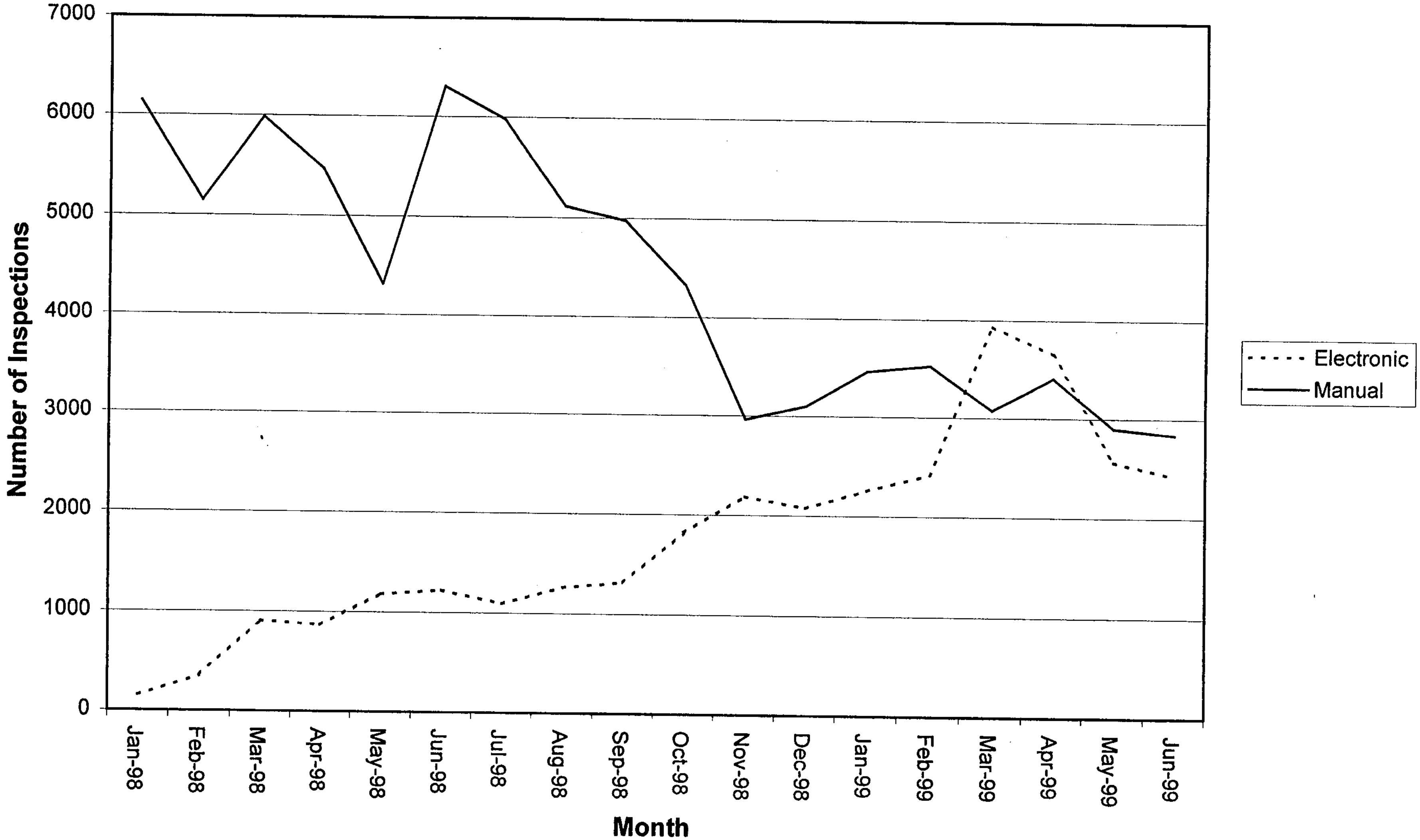


Figure 9: Number of Inspections Carried Out On Semi Trailer (ST).



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3.2 EFFICIENCY

Efficiency is measured as the time taken to conduct an inspection. Figure 10 shows the average time taken to conduct electronic and manual inspections aggregated for all levels of inspections at all locations in Maryland. As observed, the time taken to conduct a manual inspection has remained steady within a range of 19.7 minutes to 23.3 minutes, with an average inspection time of 21.7 minutes. The time taken to conduct electronic inspections is higher compared to that of manual inspections. There are a number of possible reasons for the increase in the inspection time for electronic inspections. The major reason for this could be the "learning curve" phenomenon associated with the implementation of a new system. Other possible reasons include initial system deployment problems and the increased number of violations cited with electronic inspections. Although the average inspection time for electronic inspections is higher initially, it shows a decreasing trend over time. Additionally, the time taken for electronic inspection is converging to a slightly higher value than the time taken for manual inspections. This may imply that the "learning curve" phenomenon has a marginal influence on the time taken to conduct electronic inspections.

Figures 11 through 13 show the average inspection time in minutes, based on the primary levels of inspection for the two major truck types. For Level I inspections, the average time for both electronic as well as manual inspections is generally higher for semi trailers (Figure 11). As shown in Figure 10, electronic inspections generally take more time than manual inspections for both types of trucks.

As shown in Figure 12 for Level II inspections, the average time for both electronic as well as manual inspections is generally higher for semi trailers. Additionally, for both types of trucks, the average time taken for electronic inspections converges with the average time taken for manual inspections.

Figure 13 shows that while there is no discernible difference for the time taken to conduct Level III electronic inspection on a semi trailer or a straight truck, the average time taken to conduct manual Level III inspections is consistently marginally higher for semi trailers.

Further analysis is carried out to test if the increased number of violations cited for electronic inspections (see Section 3.3) influences the time to conduct inspection. Figures 14 and 15 show the average inspection time in minutes for Level I inspections that did not result in any citation for the two major truck types. As observed in these figures, although the time taken for electronic inspection is initially higher, it converges to the time taken for manual inspections. Additionally, for straight trucks, the average time for electronic inspections decreased in the last four months. A comparison of this figure with Figure 11 emphasizes the possibility that the number of violations cited can increase the average time to conduct an inspection. The higher time to conduct electronic inspections during the initial months can be attributed to the "learning curve" phenomenon and/or initial system deployment problems.

In conclusion, electronic inspections show a trend towards increased efficiency. It may be that electronic inspections are indeed more efficient compared to manual inspections. This can only be substantiated when similar data are captured and analyzed for the coming months. Electronic inspection systems have not been fully deployed, and it is possible that the "learning curve" phenomenon may still be influencing the average time taken for conducting inspections. Once the electronic inspection systems have been fully deployed and used, then it is anticipated that further efficiency gains can accrue as the influence of the "learning curve" phenomenon diminishes.

Figure 10: Average Time Taken to Conduct Inspections (All Levels).

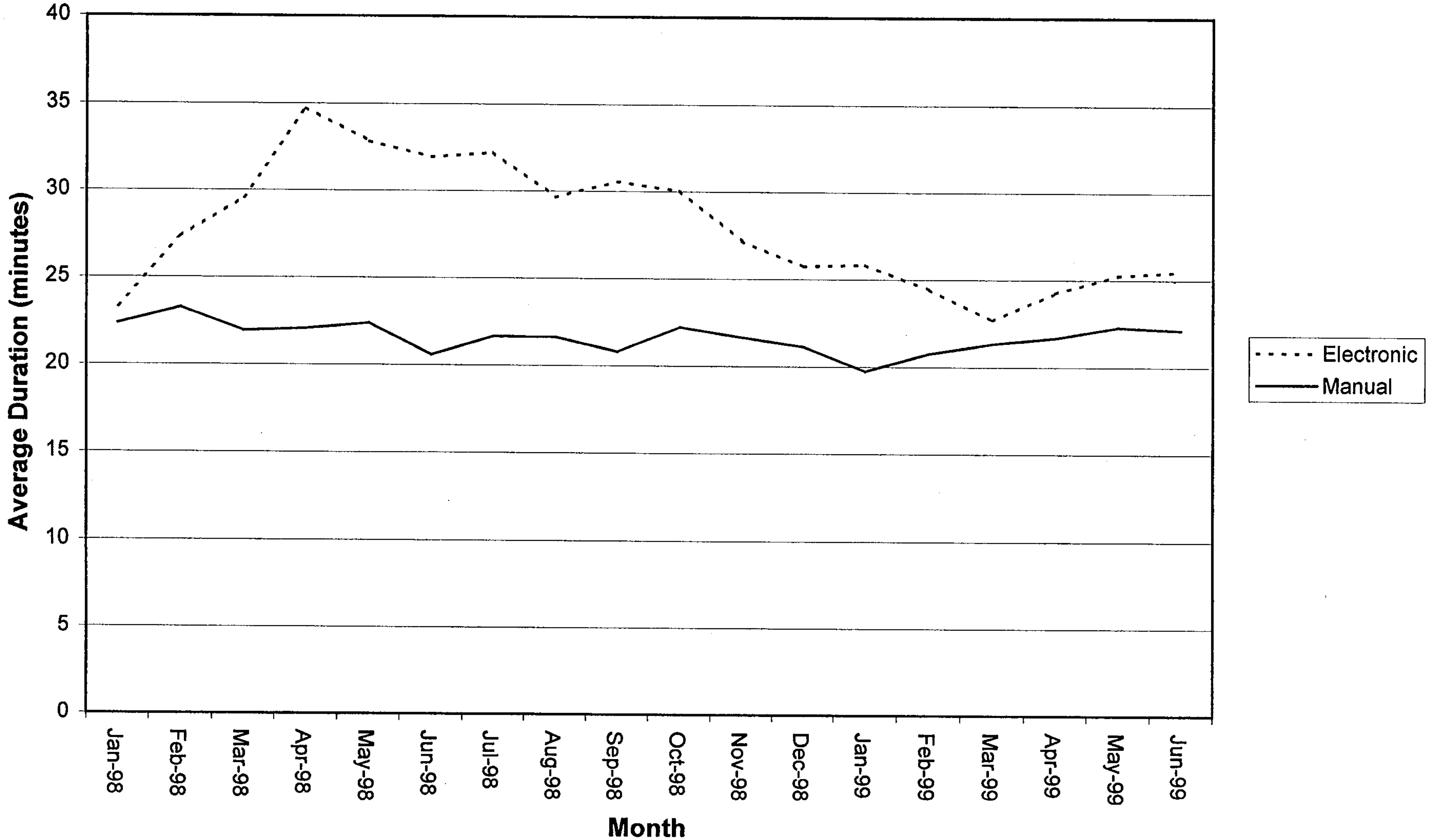


Figure 11: Average Inspection Duration (Level I) of Semi Trailer (ST) Compared to Straight Truck (TR).

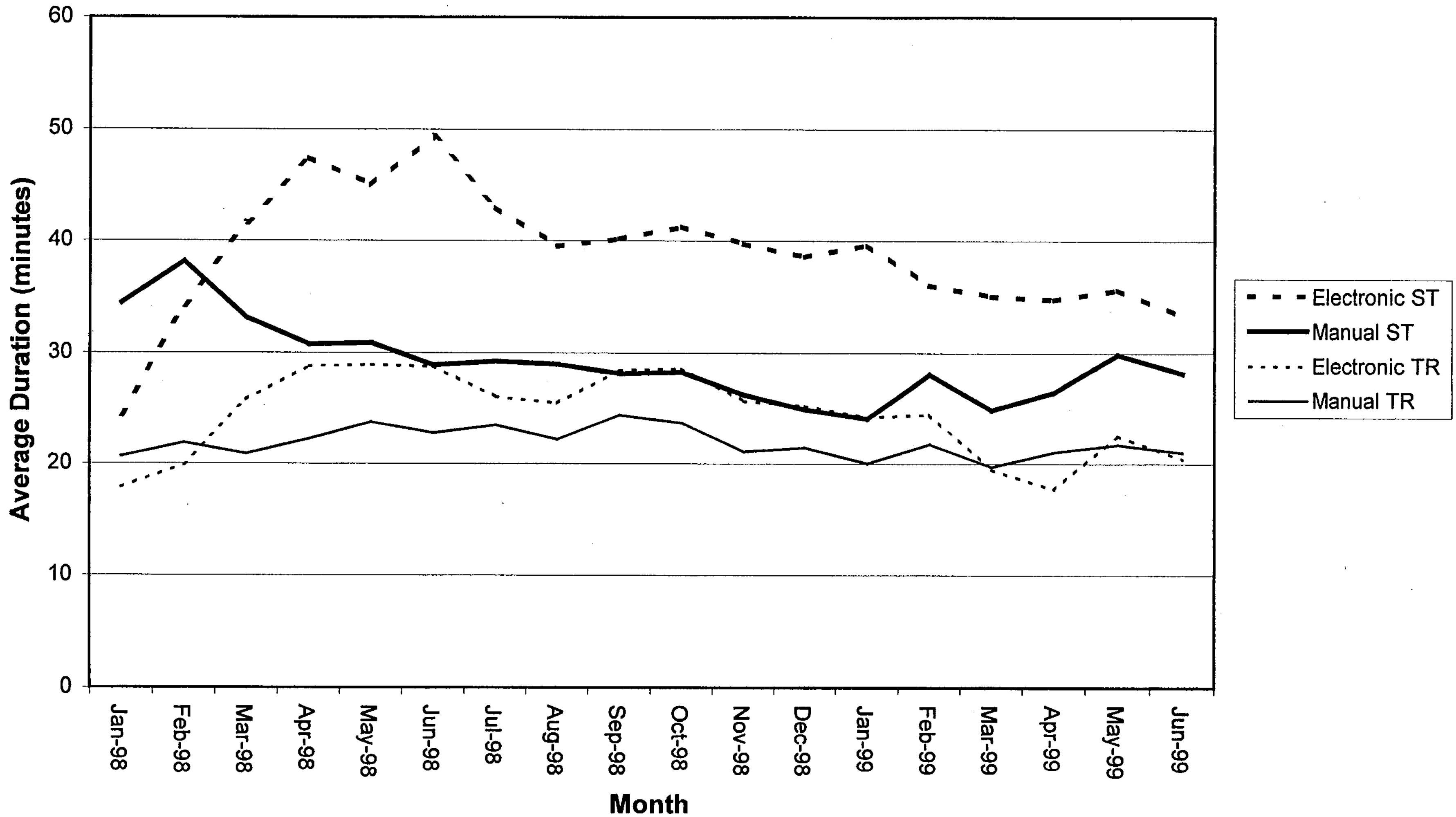


Figure 12: Average Inspection Duration (Level II) of Semi Trailer (ST) Compared to Straight Truck (TR).

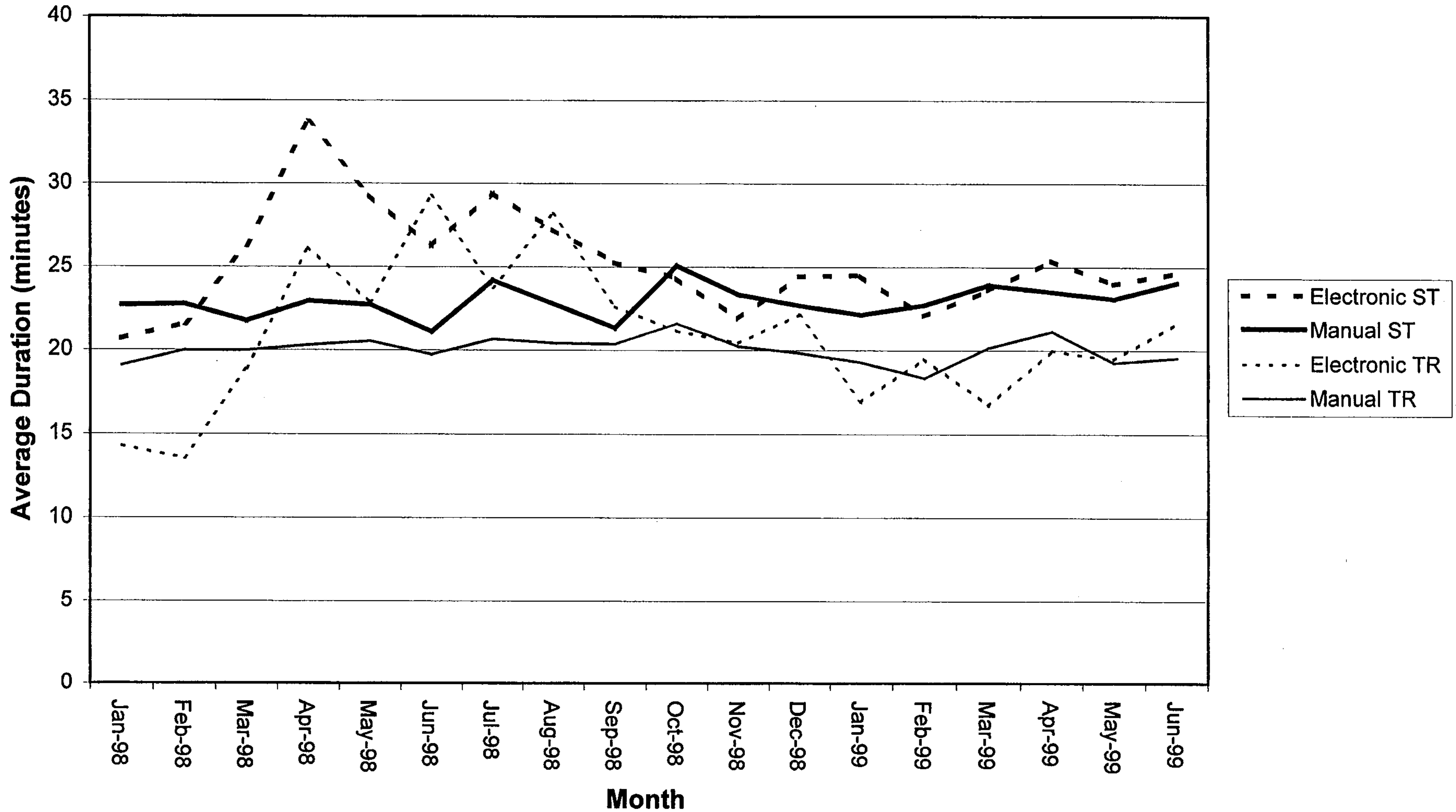


Figure 13: Average Inspection Duration (Level III) of Semi Trailer (ST) Compared to Straight Truck (TR).

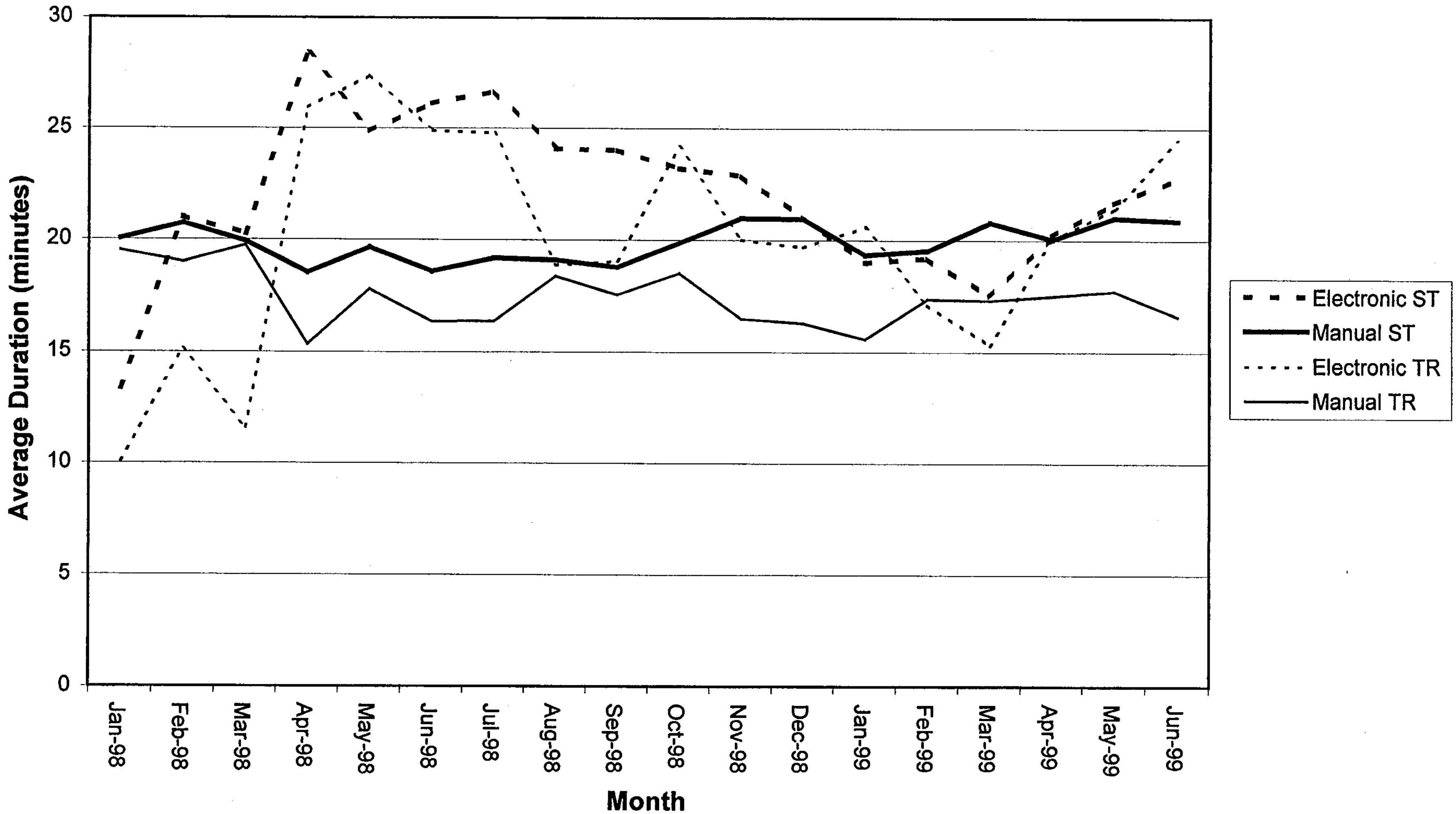


Figure 14: Average Time to Conduct an Inspection with No Violations Cited by Truck Type: Semi Trailer (Level I).

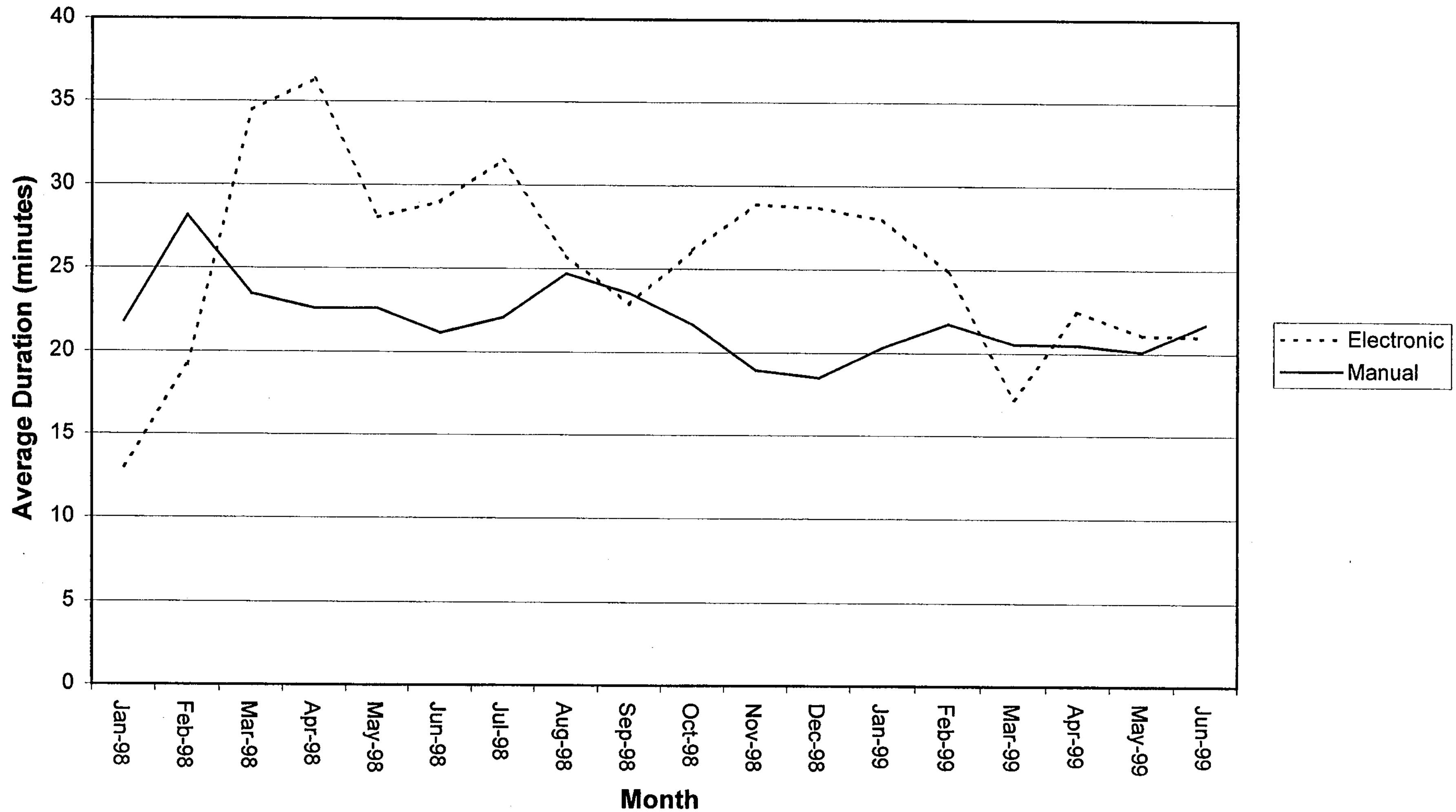
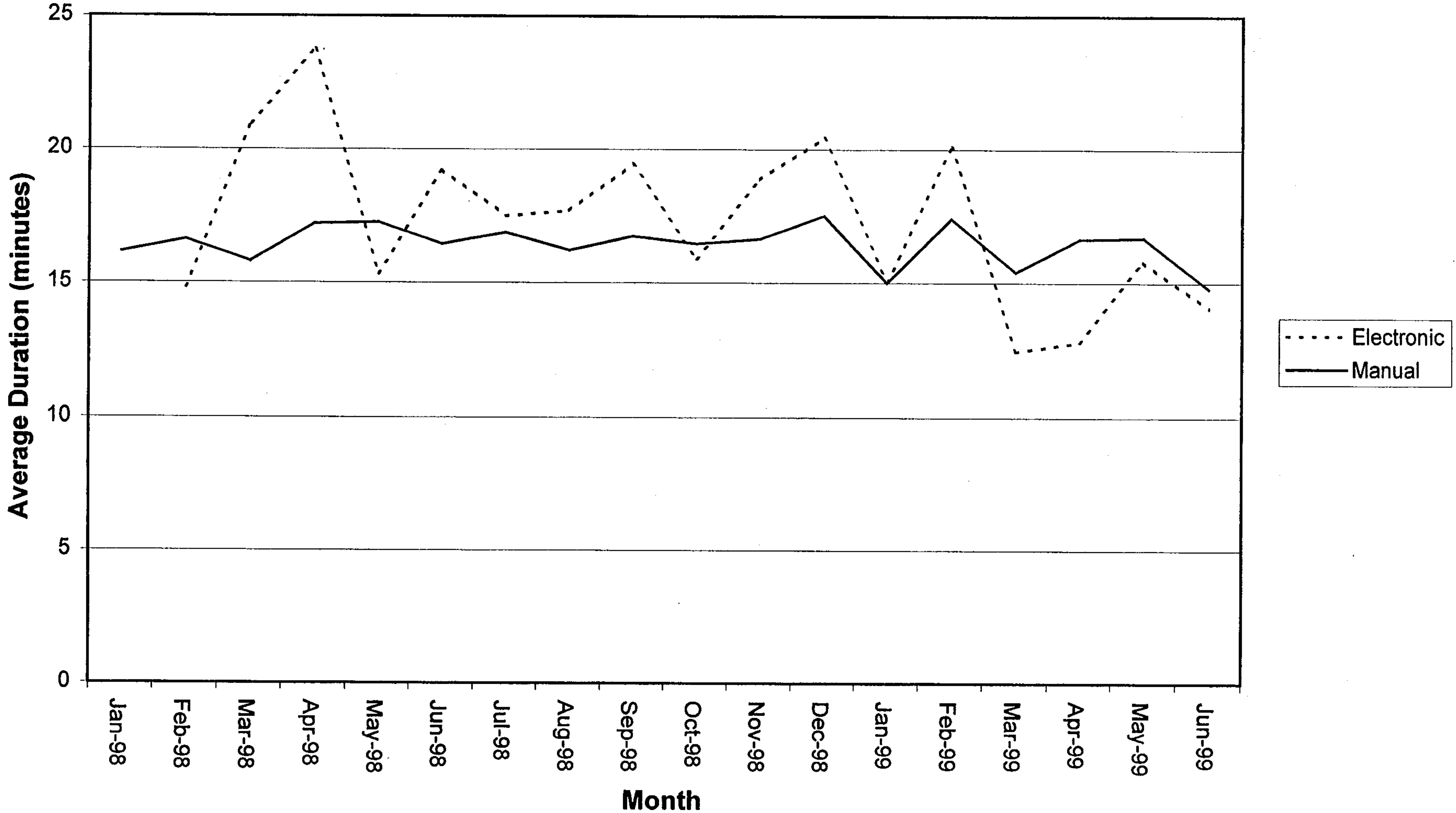


Figure 15: Average Time to Conduct an Inspection with No Violations Cited by Truck Type: Straight Truck (Level I).



3.3 EFFECTIVENESS

For this study, effectiveness of the CVISN safety assurance program is defined as the identification of high-risk carriers, vehicles, and drivers. Electronic inspections can aid in identifying these high-risk carriers, vehicles, and drivers through the use of (ISS) and the Past Inspection Query (PIQ) systems. For inspection systems, effectiveness measures the number of violations cited at weigh/inspection facilities and by roving crews in Maryland. Good measures of effectiveness are the average number of violations cited per inspection and the percent of inspections that result in a violation(s) being cited. SAFETYNET maintains two types of violations: violations that do not result in a vehicle/driver being placed out-of-service (OOS), and violations that result in either the vehicle and/or the driver being placed OOS.

3.3.1 Violations (Excluding OOS)

Figure 16 shows the average number of violations cited per inspection for all levels. As seen from the figure, the average number of violations cited is higher for electronic inspections than for manual inspections. However, during the later months, the difference between these two inspection processes has decreased for the average number of violations cited per inspection.

Figures 17 through 19 show the average number of violations cited per inspection for both electronic and manual inspections at Levels I, II, and III. As can be seen from these three figures, the majority of violations are cited at Level I, while very few violations are cited at Level III. At Level I, an average of 3.03 violations are cited per manual inspection and 4.37 violations are cited per electronic inspection during the 18-month time period. At Level II, the corresponding values are 1.53 and 1.33 violations per inspection, respectively; at Level III, the corresponding values are 0.67 and 0.58 violations per inspection, respectively. For Level I (Figure 17), the average number of violations cited for electronic inspections is consistently higher. However, during the later months, the difference between the average number of violations cited per inspection between these two inspection processes has decreased. Additionally, the average number of violations cited per inspection for electronic inspection at Level I exhibits a declining trend starting from May 1998. Figures 18 and 19 show that for Levels II and III, the average number of violations cited is lower for electronic inspections than for manual inspections.

Further analysis on the average number of violations cited per inspection by the two major truck types has been performed. As shown in Figure 20, for straight trucks, there is no observable difference between electronic and manual inspections with respect to the average number of violations cited per inspection. In contrast, for semi trailers, electronic inspections have a higher number of average violations cited per inspection when compared to manual inspections. However, during the later months, the difference between the average number of violations cited per inspection between these two inspection processes decreased for semi trailers.

Figure 21 shows the percent of inspections that result in one or more violations being cited for all levels. As seen from the figure, there is no observable difference between electronic and manual inspections in terms of the percent of inspections with one or more cited violations.

Figure 22 shows the percent of inspections that result in one or more violations being cited for both electronic and manual inspections at Levels I, II, and III. As can be seen from the figure, most of the inspections at Level I result in a violation being cited. In contrast, fewer of the inspections at Levels II and III result in a violation being cited. At Level I, an average of 78.8% of the manual inspections cited violations, whereas 90.2% of the electronic inspections cited violations during the 18-month time period. At Level II, the corresponding values are 62.1% and 61.4%, respectively; for Level III, the corresponding values are 45.5% and 39.9%, respectively. For Level I, the average percent of inspections being cited for violations is consistently higher for electronic inspections. However, during the later months, the difference between the percent of inspections that result in one or more violations being cited between these two inspection processes decreased. Additionally, the percent of inspections that result in one or more violations being cited for electronic inspection at Level I exhibits a declining trend starting from May 1998. The same figure shows that, for Level III, the average percent of inspections with violations being cited is lower for electronic inspections than for manual inspections. There is no observable difference between electronic and manual inspections at Level II.

Further analysis on the percent of inspections that result in one or more violations being cited by the two major truck types was carried out. As shown in Figure 23, for straight trucks, a higher percentage of inspections results in one or more violations being cited. Additionally, for both types of trucks, a higher percentage of electronic inspections results in one or more violations being cited. However, during the later months, the difference between the percent of inspections that result in one or more violations being cited between these two inspection processes decreased for both types of trucks.

Figure 24 shows that, for Level V, violations are cited for a significantly higher percentage of manual inspections than for electronic inspections.

In conclusion, more violations are cited a) per electronic inspection, b) at Level I, and c) for straight trucks. Moreover, the percent of inspections resulting in one or more violations cited is higher a) for electronic inspections, b) at Level I, and c) for straight trucks. For Level V inspections, a significantly higher percent of manual inspections results in violations with citations.

Figure 16: Average Number of Violations Cited per Inspection (All Levels).

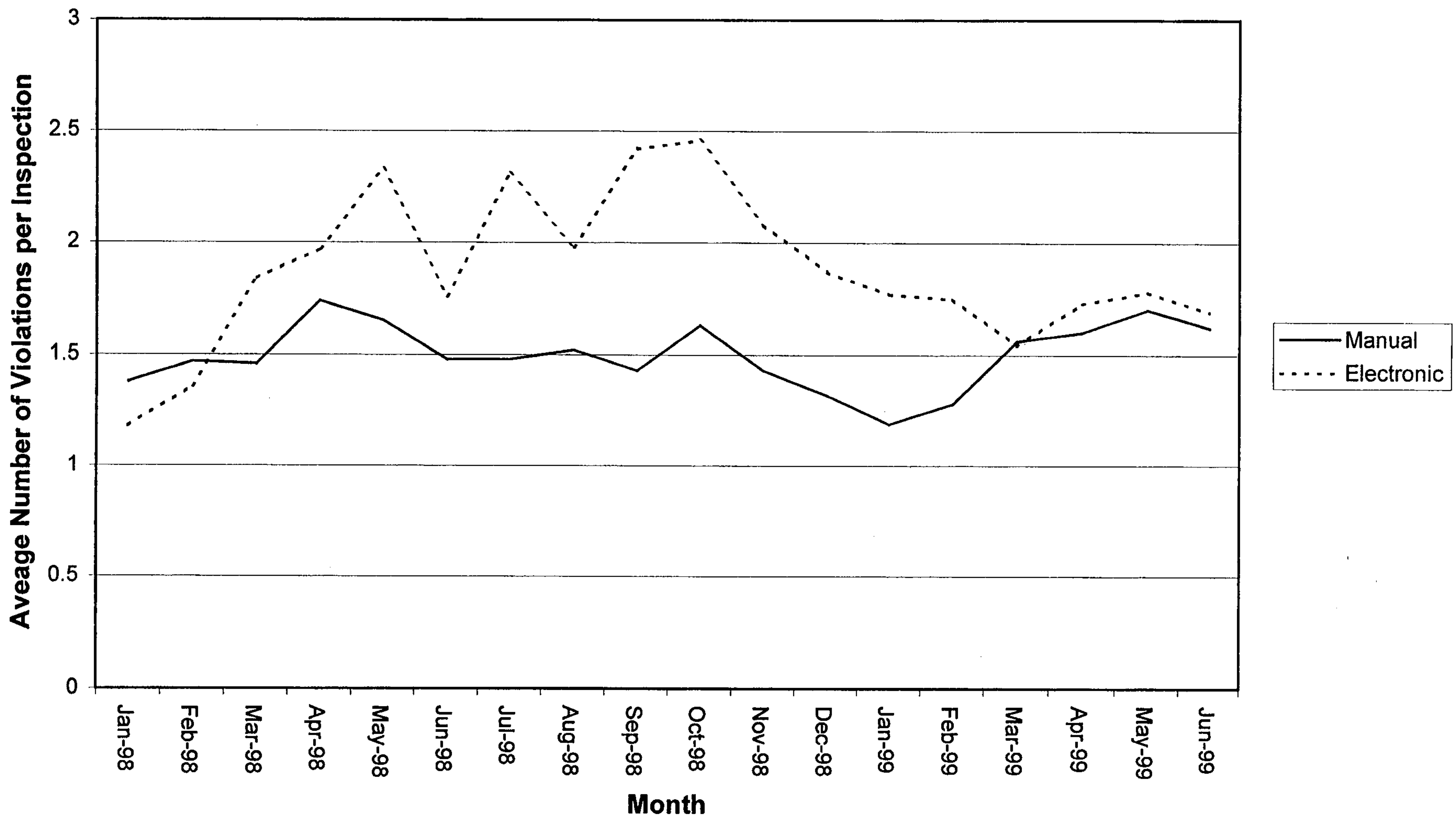


Figure 17: Average Number of Violations Cited per Inspection (Level I).

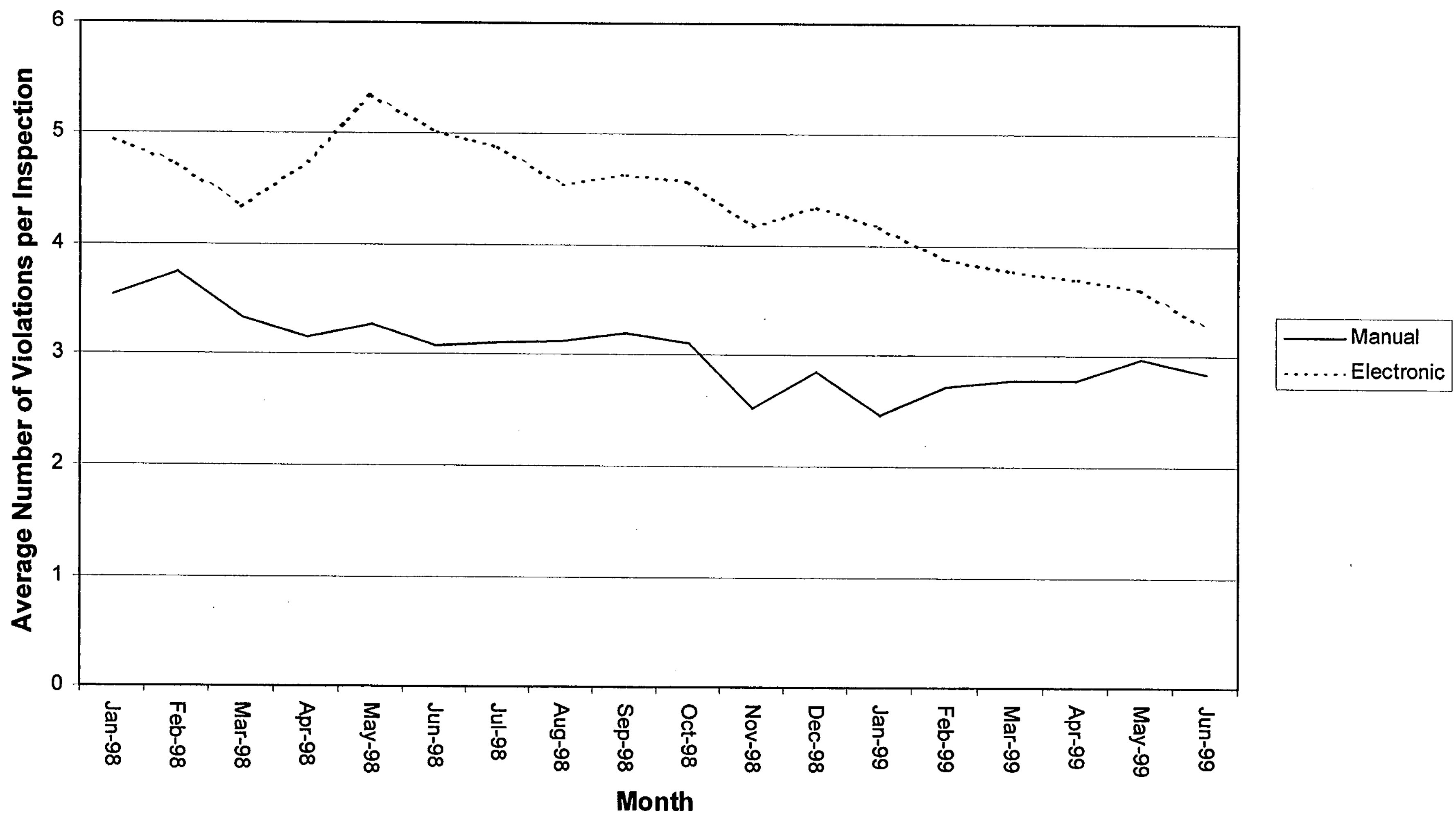


Figure 18: Average Number of Violations Cited per Inspection (Level II).

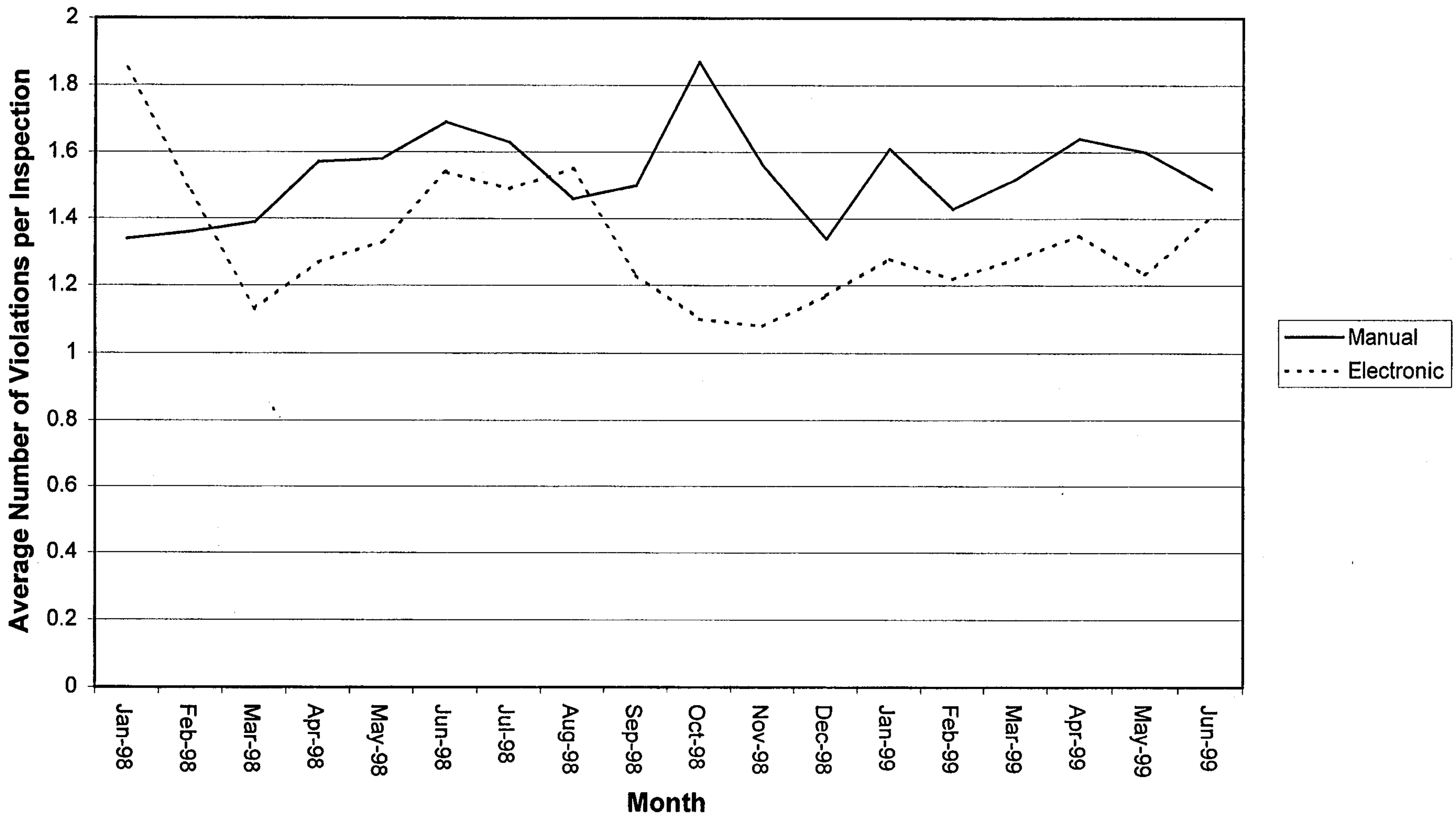


Figure 19: Average Number of Violations Cited per Inspection (Level III).

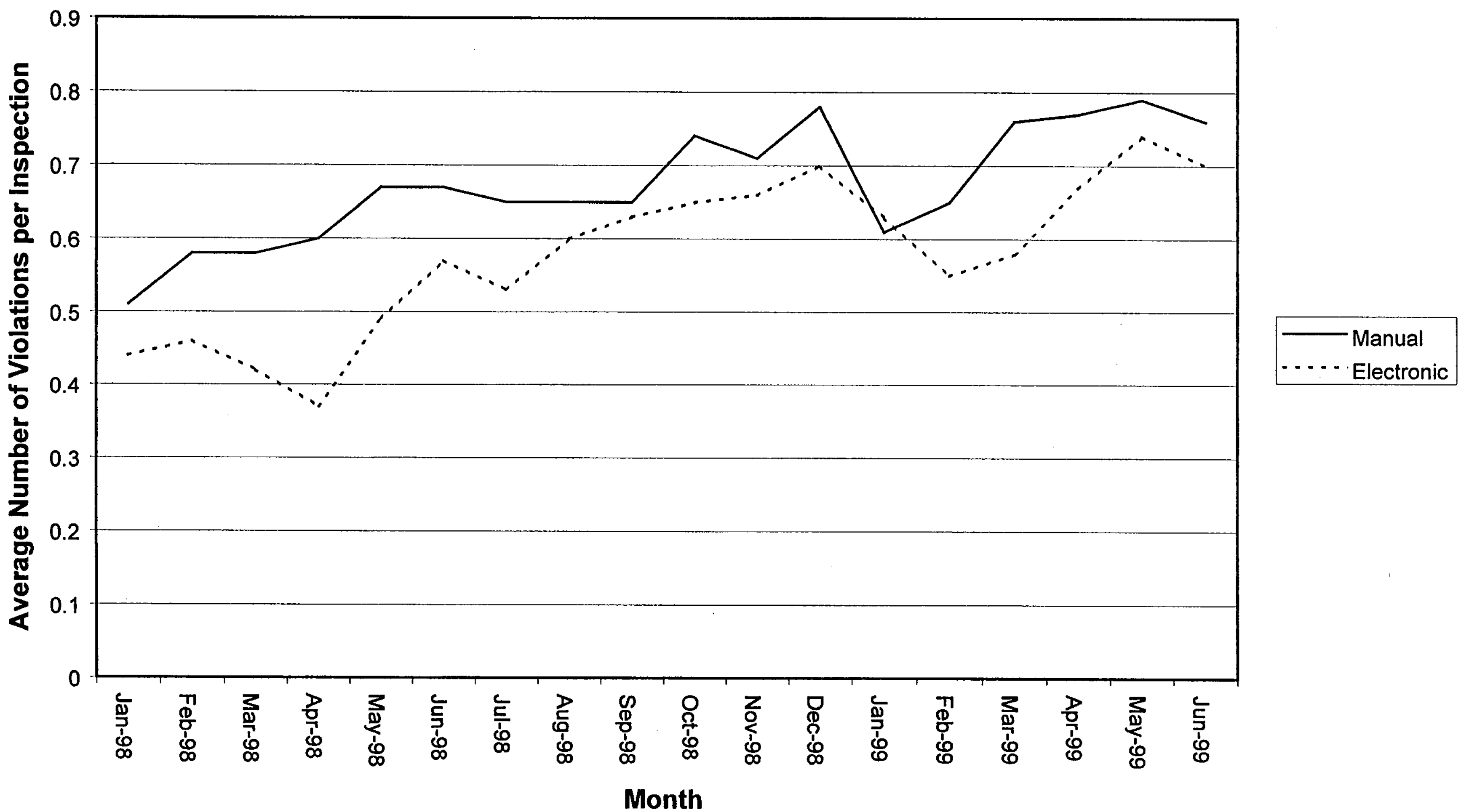


Figure 20: Average Number of Violations Cited per Inspection by Type of Truck: Semi Trailer (ST) and Straight Truck (TR).

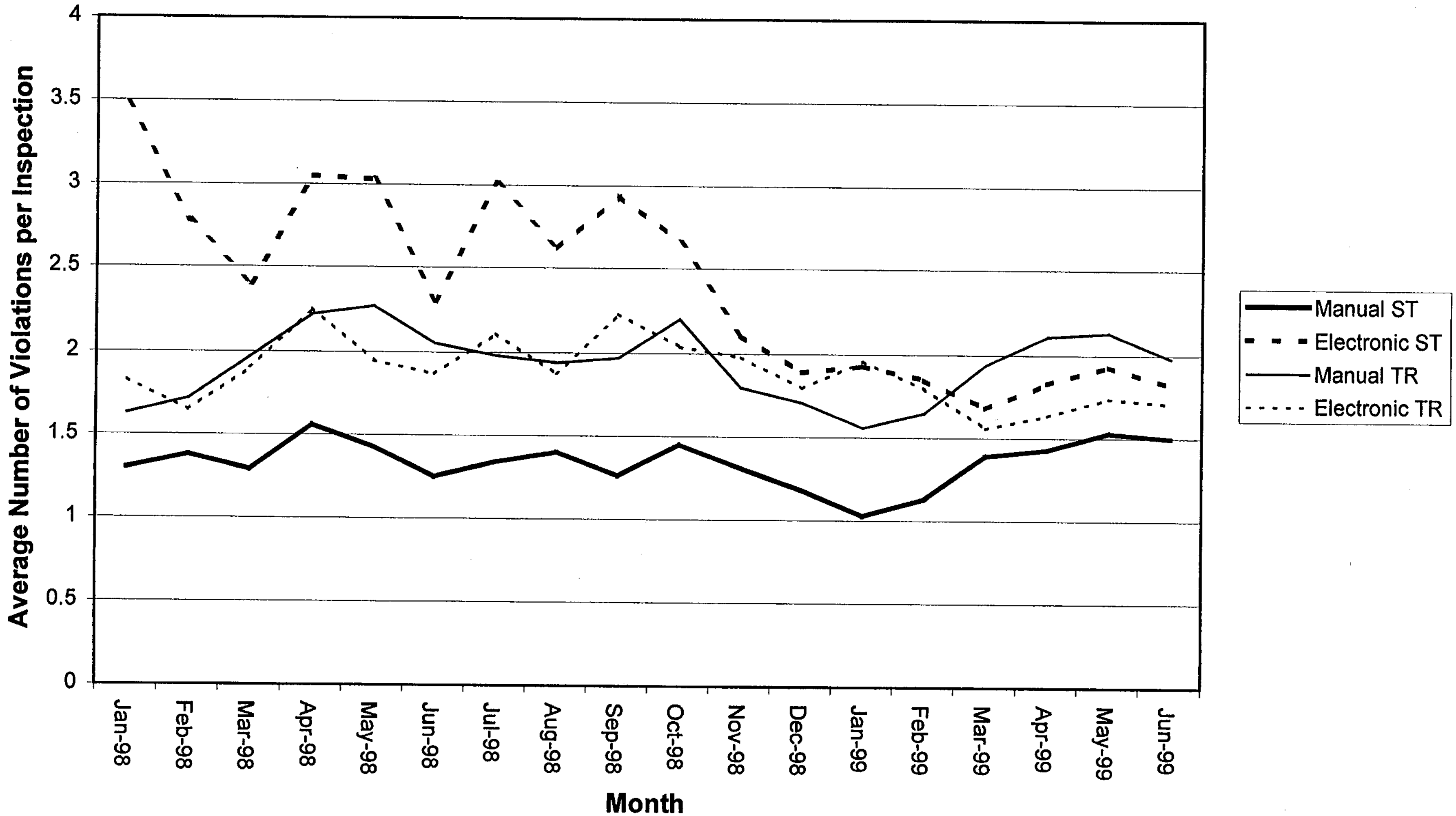


Figure 21: Percent of Inspections with Violations Cited (All Levels).

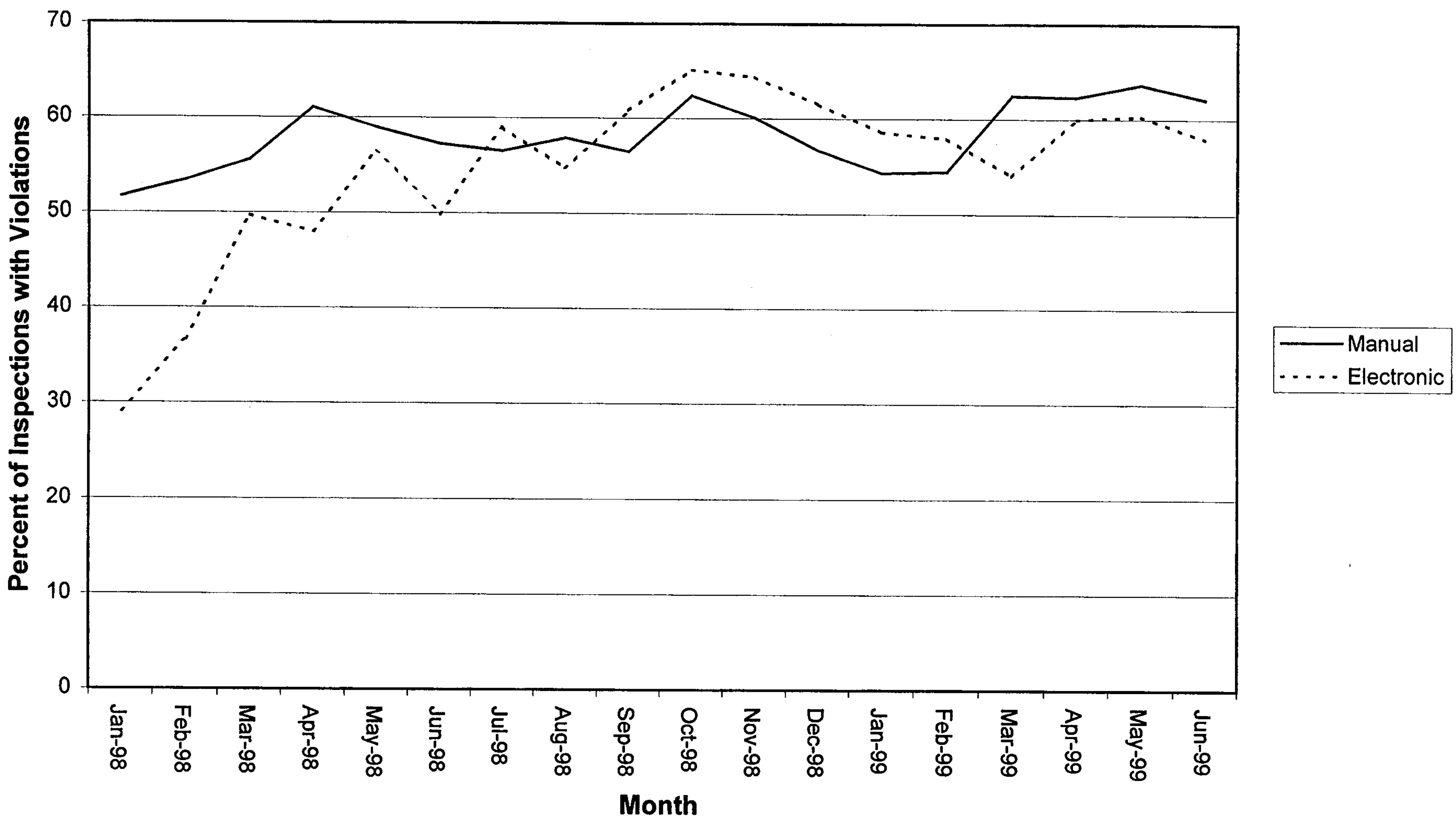


Figure 22: Percent of Inspections Resulting in Violations Cited (Levels I, II, and III).

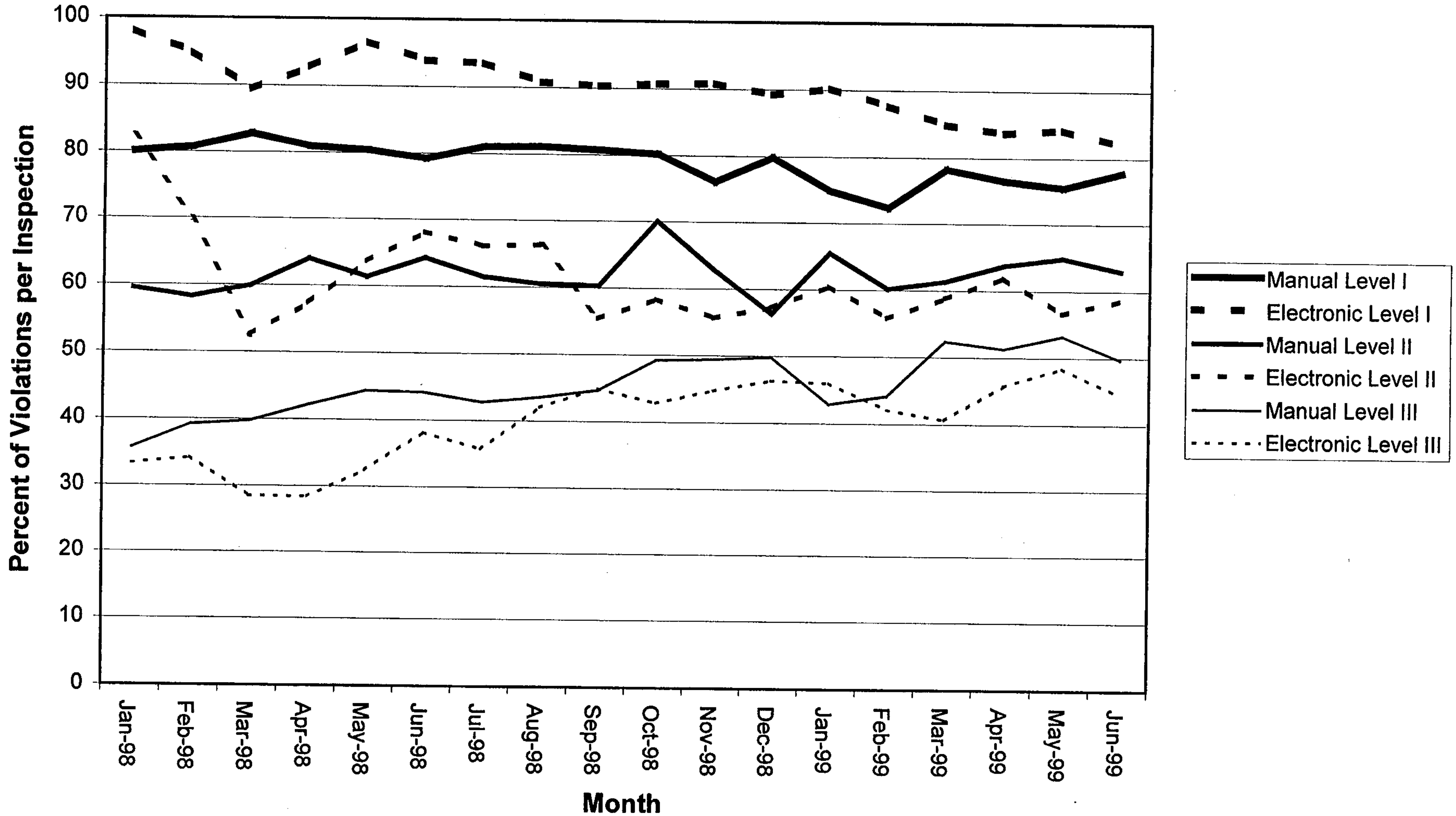


Figure 23: Percent of Inspections with Violations Cited by Type of Truck: Semi Trailer (ST) and Straight Truck (TR).

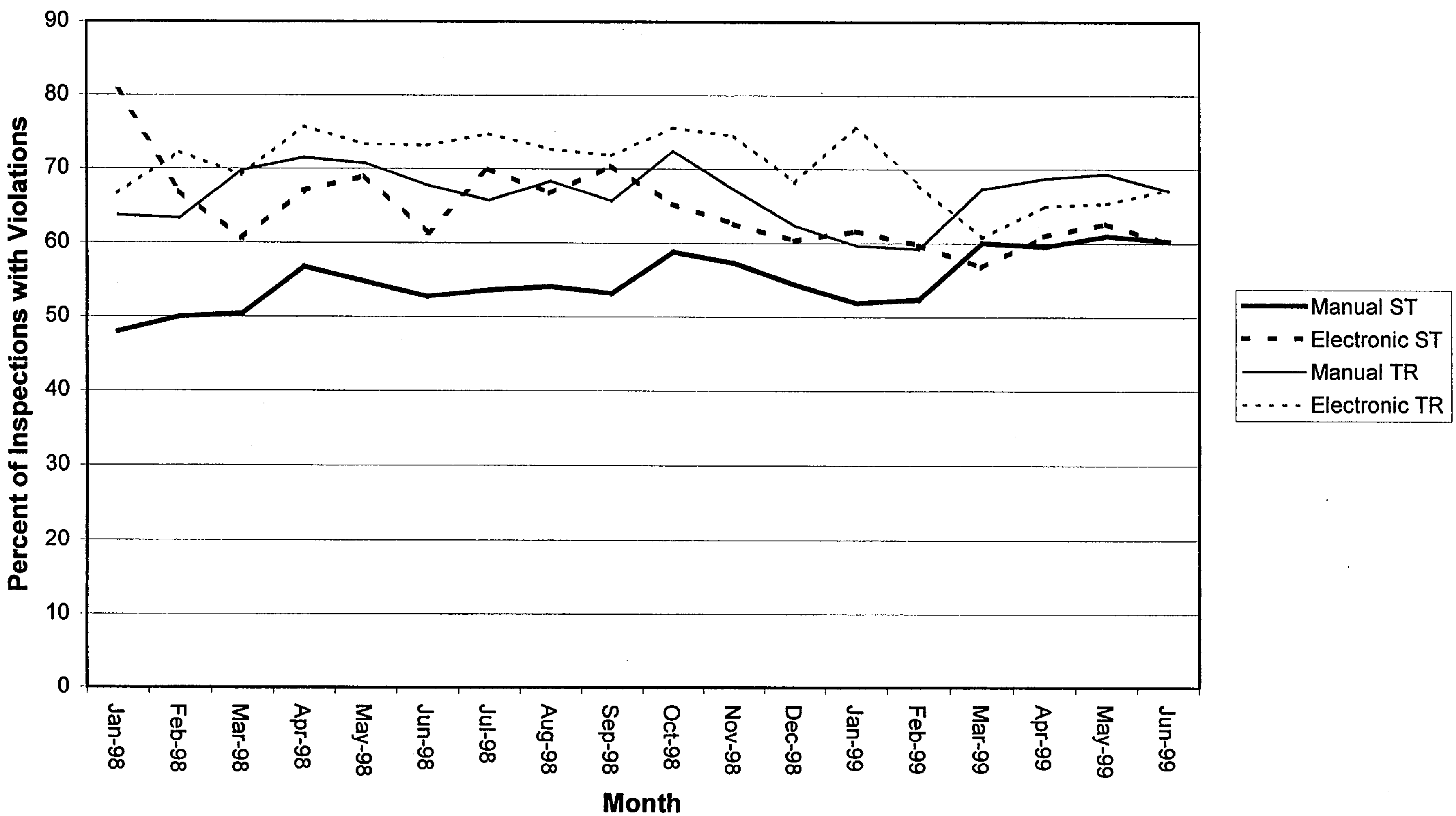
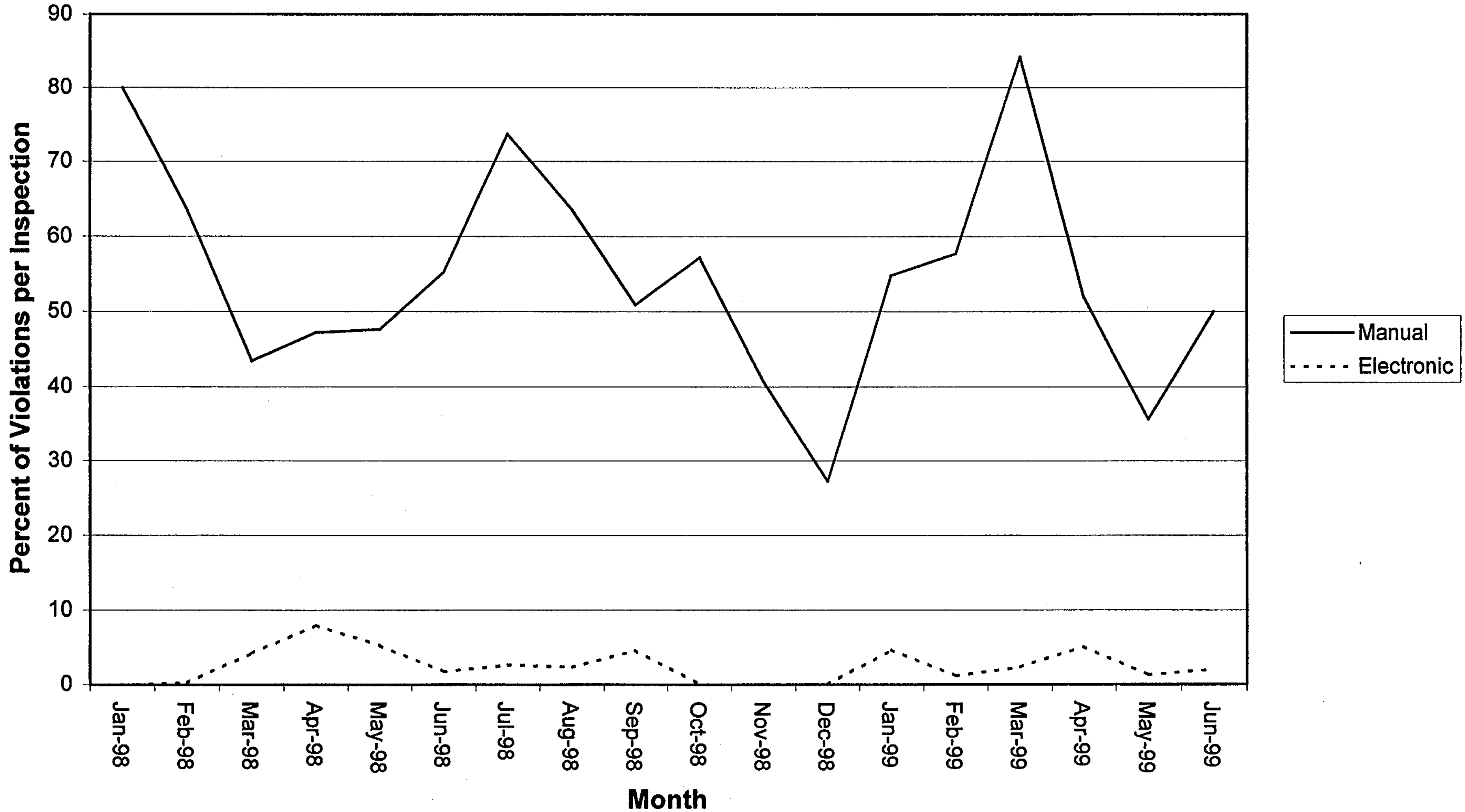


Figure 24: Percent of Inspections Resulting in Violations Cited (Level V).



3.3.2 Out-Of-Service (OOS) Violations

Figure 25 shows the average number of OOS violations cited per inspection for all levels. As seen from the figure, the average number of OOS violations cited is higher for electronic inspections than for manual inspections. However, during the later months, the difference between these two inspection processes decreased for the average number of OOS violations cited per inspection.

Figures 26 through 28 show the average number of OOS violations cited per inspection for both electronic and manual inspections at Levels I, II, and III. As can be seen from these three figures, a majority of the OOS violations are cited at Level I, while very few OOS violations are cited at Level III. At Level I, an average of 0.56 OOS violations are cited per manual inspection, and 0.90 OOS violations are cited per electronic inspection during the 18-month time period. At Level III, the corresponding values are 0.09 and 0.11 OOS violations per inspection, respectively. For Level I (Figure 26), the average number of OOS violations cited for electronic inspections is consistently higher. However, during the later months, the difference between the average number of OOS violations cited per inspection between these two inspection processes has decreased. Additionally, the average number of OOS violations cited per inspection for electronic inspection at Level I exhibits a declining trend starting from May 1998. Figures 27 and 28 show that, for Levels II and III, there is no observable difference between the electronic and manual inspection processes with respect to the average number of OOS violations cited.

Further analysis on the average number of OOS violations cited per inspection by the two major truck types has been done. As shown in Figure 29, for both types of trucks, electronic inspections have a higher number of average OOS violations cited per inspection when compared to manual inspections. However, during the later months, the difference between the average number of OOS violations cited per inspection between these two inspection processes decreased.

Figure 30 shows the percent of inspections that result in one or more OOS violations being cited for all levels. As seen from the figure, the percent of inspections that result in one or more OOS violations being cited is higher for electronic inspections than manual inspections. However, during the later months, the difference between the percent of inspections that result in one or more OOS violations being cited between these two inspection processes decreased; in fact, the percentages converged for the month of June 1999.

Figure 31 shows the percent of inspections that result in one or more OOS violations being cited for both electronic and manual inspections at Levels I, II, and III. As can be seen from the figure, the percent of inspections resulting in OOS violations being cited is highest for Level I inspections, followed by Level II inspections, and then by Level III inspections. At Level I, an average of 31.2% of the manual inspections cited OOS violations, whereas 44.2% of the electronic inspections cited OOS violations during the 18-month time period. At Level II, the corresponding values are 16.7% and 19.6%, respectively; for Level III, the corresponding values are 8.0% and 9.1%, respectively. For Level I, the average percent of inspections being cited for OOS violations is consistently higher for electronic inspections. However, during the later months, the difference between the percent of inspections that result in one or more OOS violations being cited between these two inspection processes decreased.

Additionally, the percent of electronic inspections that result in one or more OOS violations being cited at Level I exhibits a declining trend starting from May 1998. There is no observable difference between electronic and manual inspections at Levels II and III.

Further analysis on the percent of inspections that result in one or more OOS violations being cited by the two major truck types was carried out. As shown in Figure 32, for straight trucks, a higher percentage of inspections results in one or more OOS violations being cited. Additionally, for both types of trucks, a higher percentage of electronic inspections results in one or more OOS violations being cited. However, during the later months, the difference between the percent of electronic and manual inspections that result in one or more OOS violations being cited decreased for both types of trucks.

Figure 33 shows that, for Level V, OOS violations are cited for a significantly higher percentage of manual inspections than for electronic inspections.

In conclusion, more OOS violations are cited a) per electronic inspection, b) at Level I, and c) for straight trucks. Moreover, the percent of inspections resulting in one or more violations cited is higher a) for electronic inspections, b) at Level I, and c) for straight trucks. For Level V inspections, a significantly higher percent of manual inspections have OOS violations with citations.

Figure 25: Average Number of Out-of-Service (OOS) Violations Cited per Inspection (All Levels).

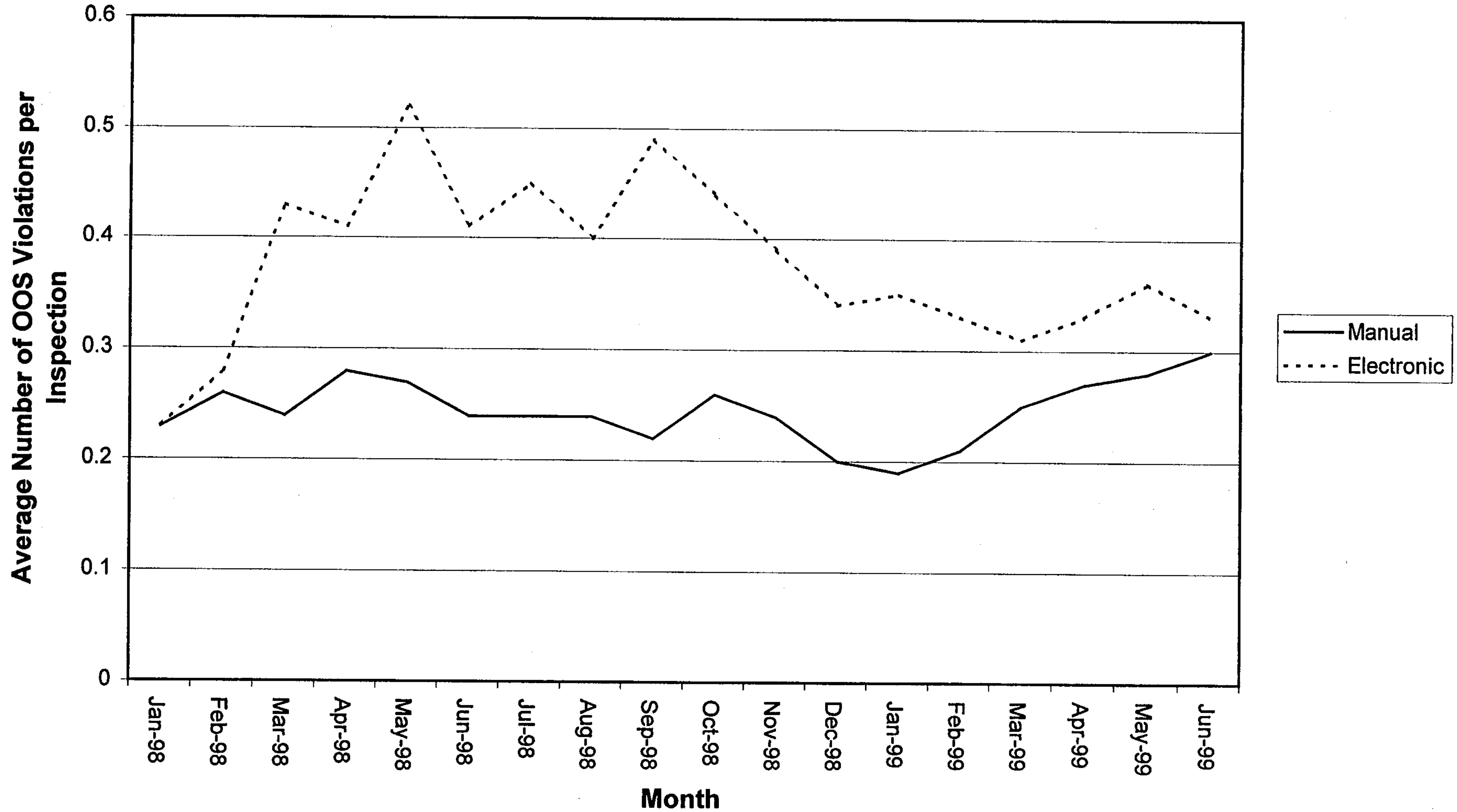


Figure 26: Average Number of Out-of-Service (OOS) Violations Cited per Inspection (Level I).

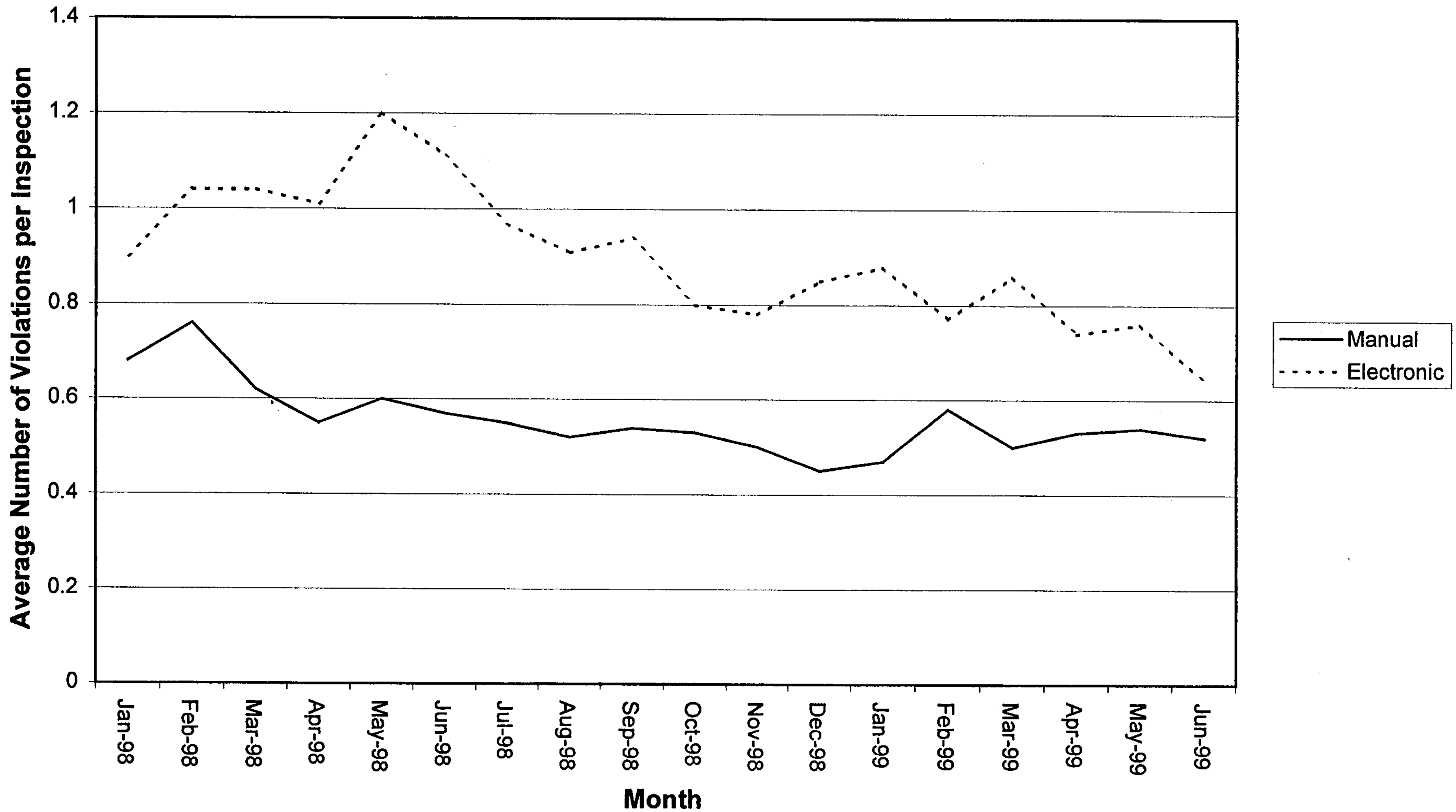


Figure 27: Average Number of Out-of-Service (OOS) Violations Cited per Inspection (Level II).

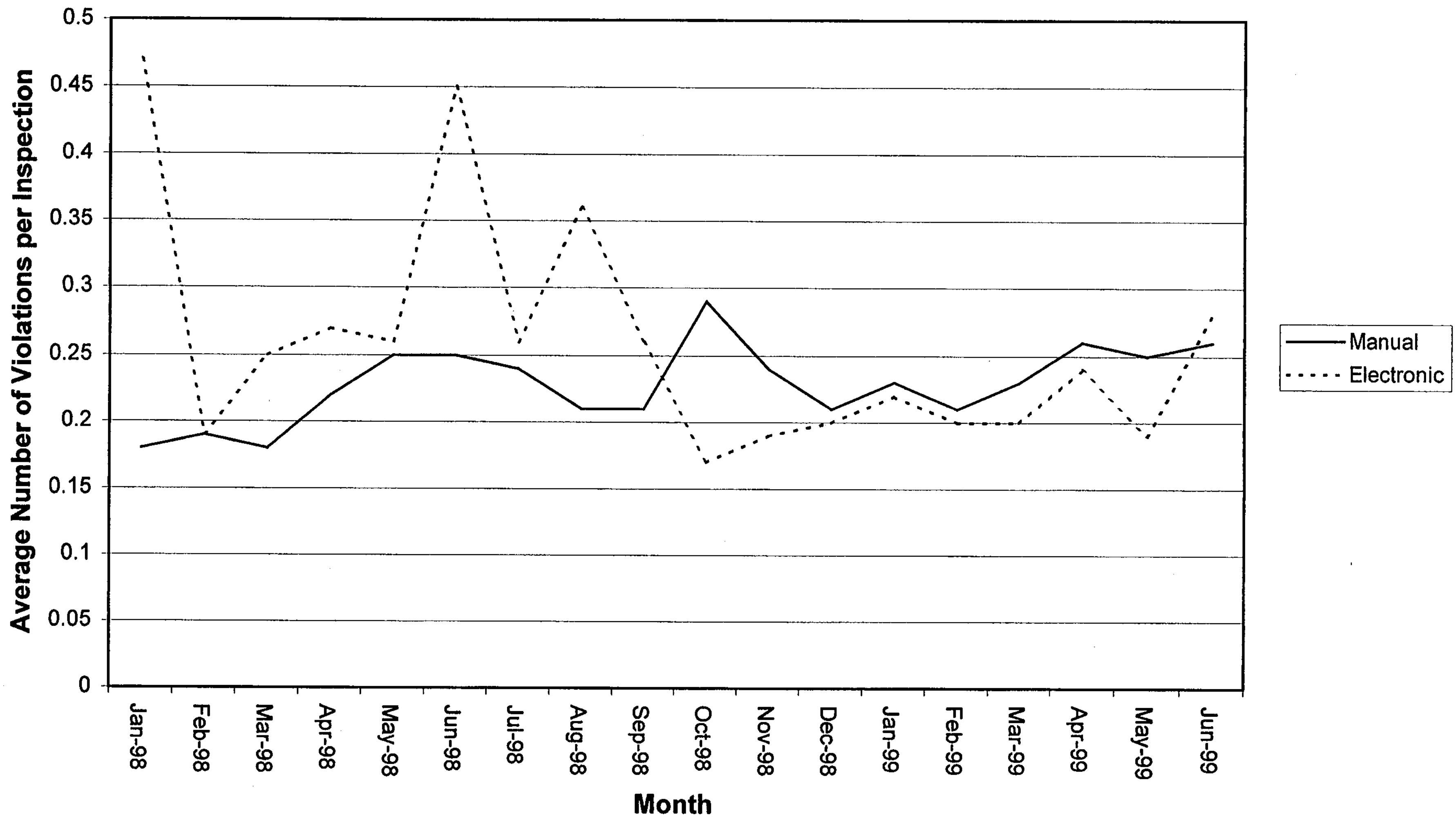


Figure 28: Average Number of Out-of-Service (OOS) Violations Cited per Inspection (Level III).

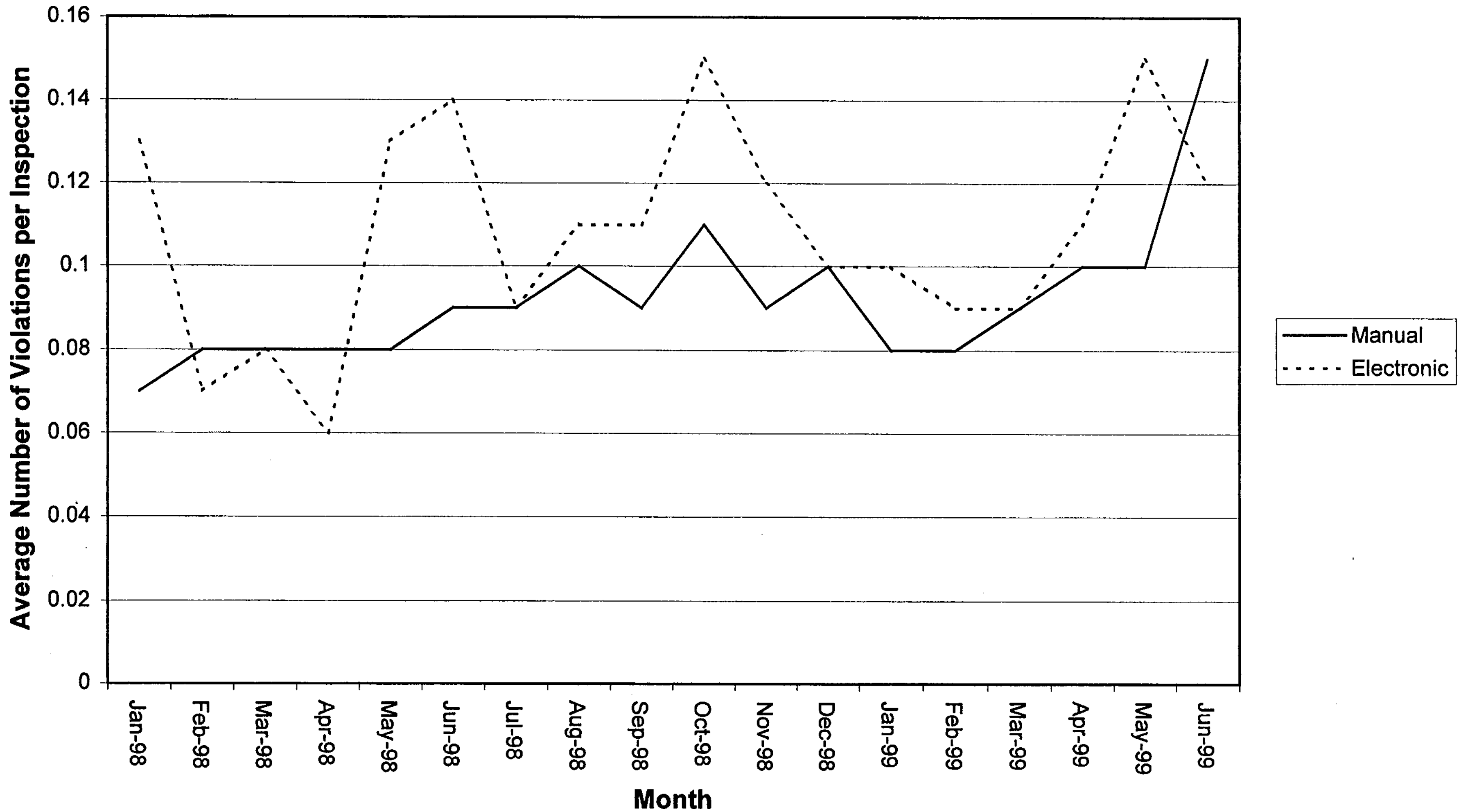


Figure 29: Average Number of Inspection with Out-of-Service (OOS) Violations Cited by Type of Truck: Semi Trailer (ST) and Straight Truck (TR).

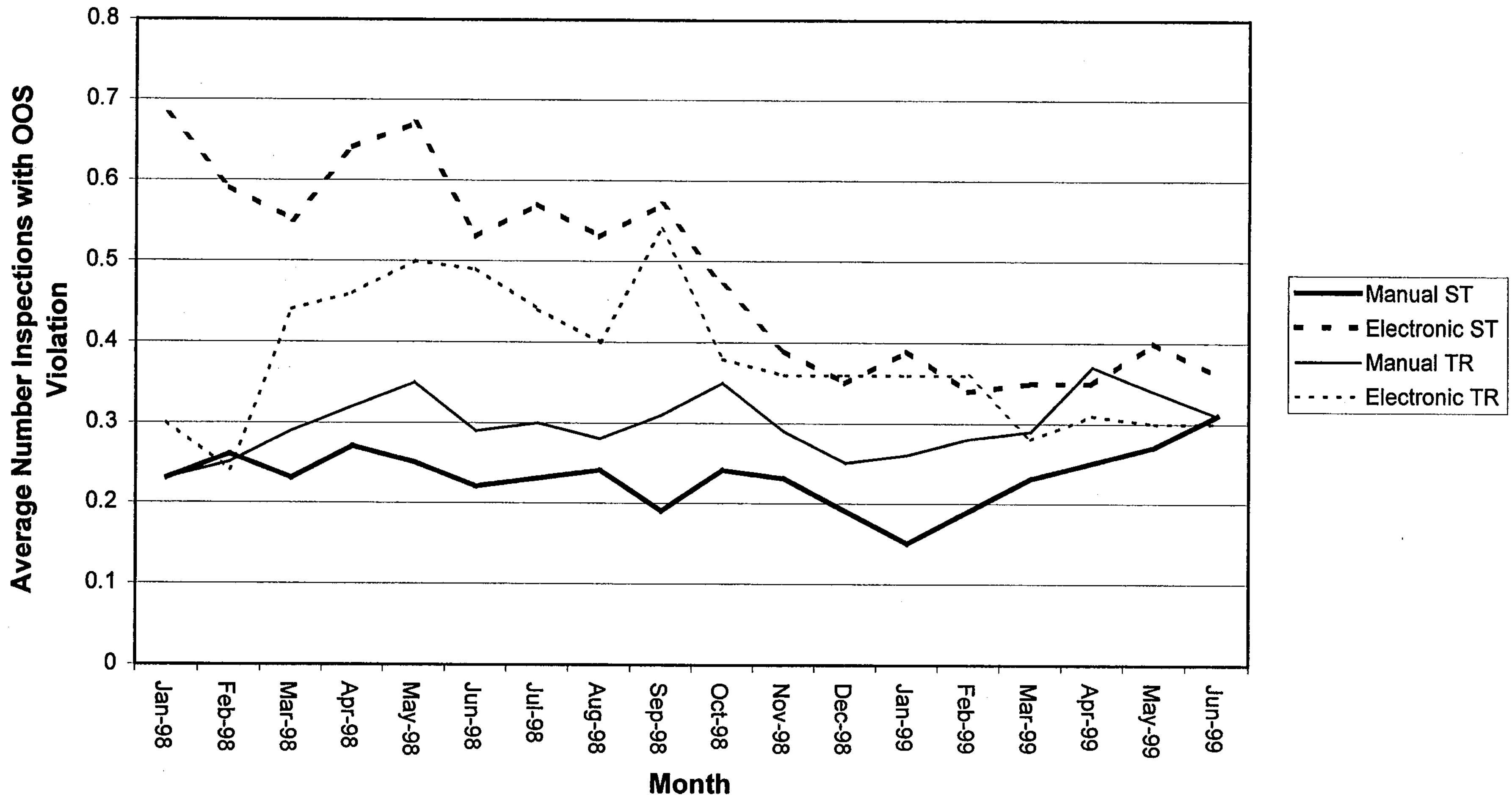


Figure 30: Percent of Inspections with Out-of-Service (OOS) Violations Cited (All Levels).

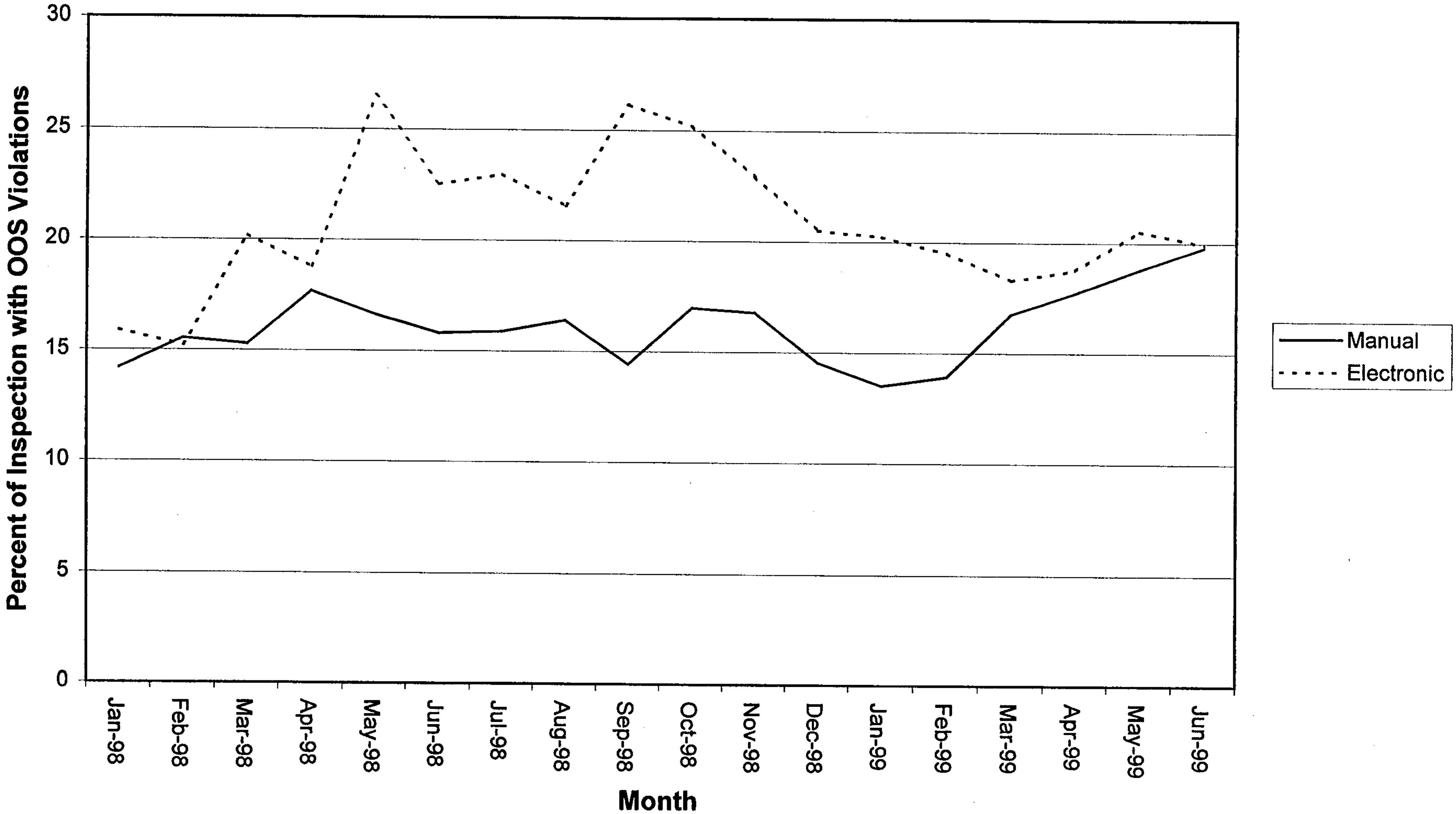


Figure 31: Percent of Inspections With Out-of-Service (OOS) Violations Cited (Levels I, II, and III).

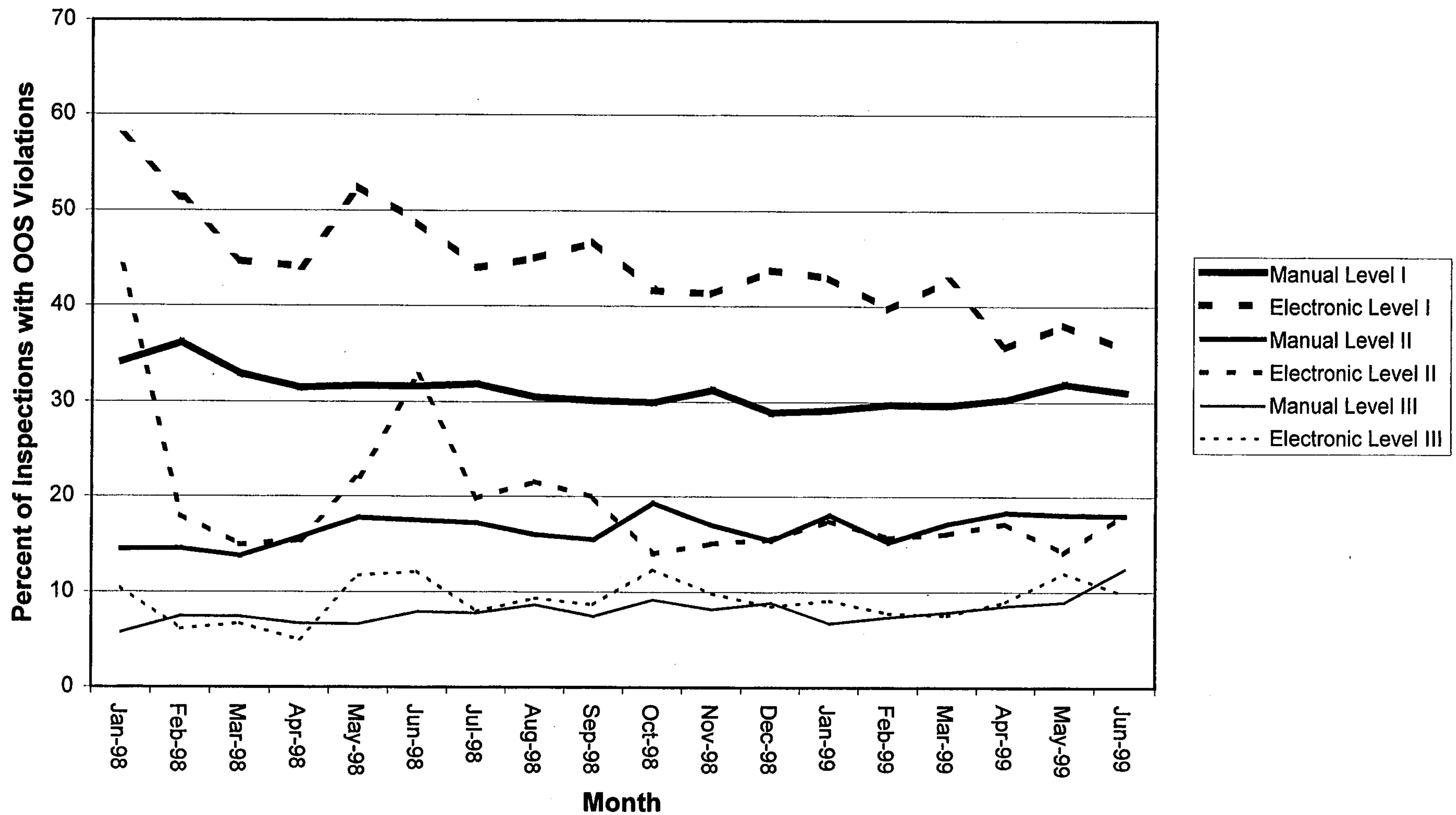


Figure 32: Percent of Inspections with Out-of-Service (OOS) Violations Cited by Type of Truck: Semi Trailer (ST) and Straight Truck (TR).

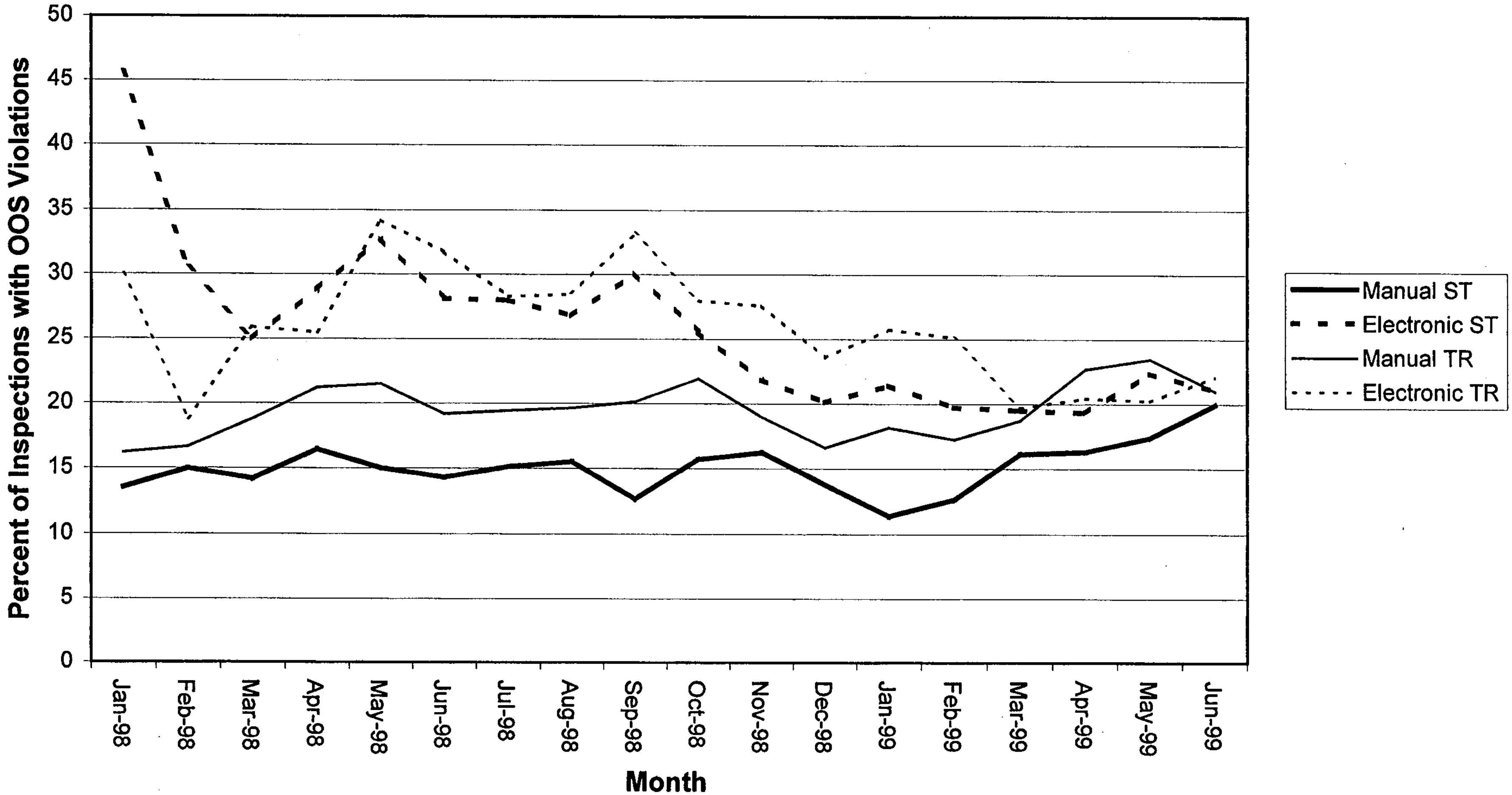
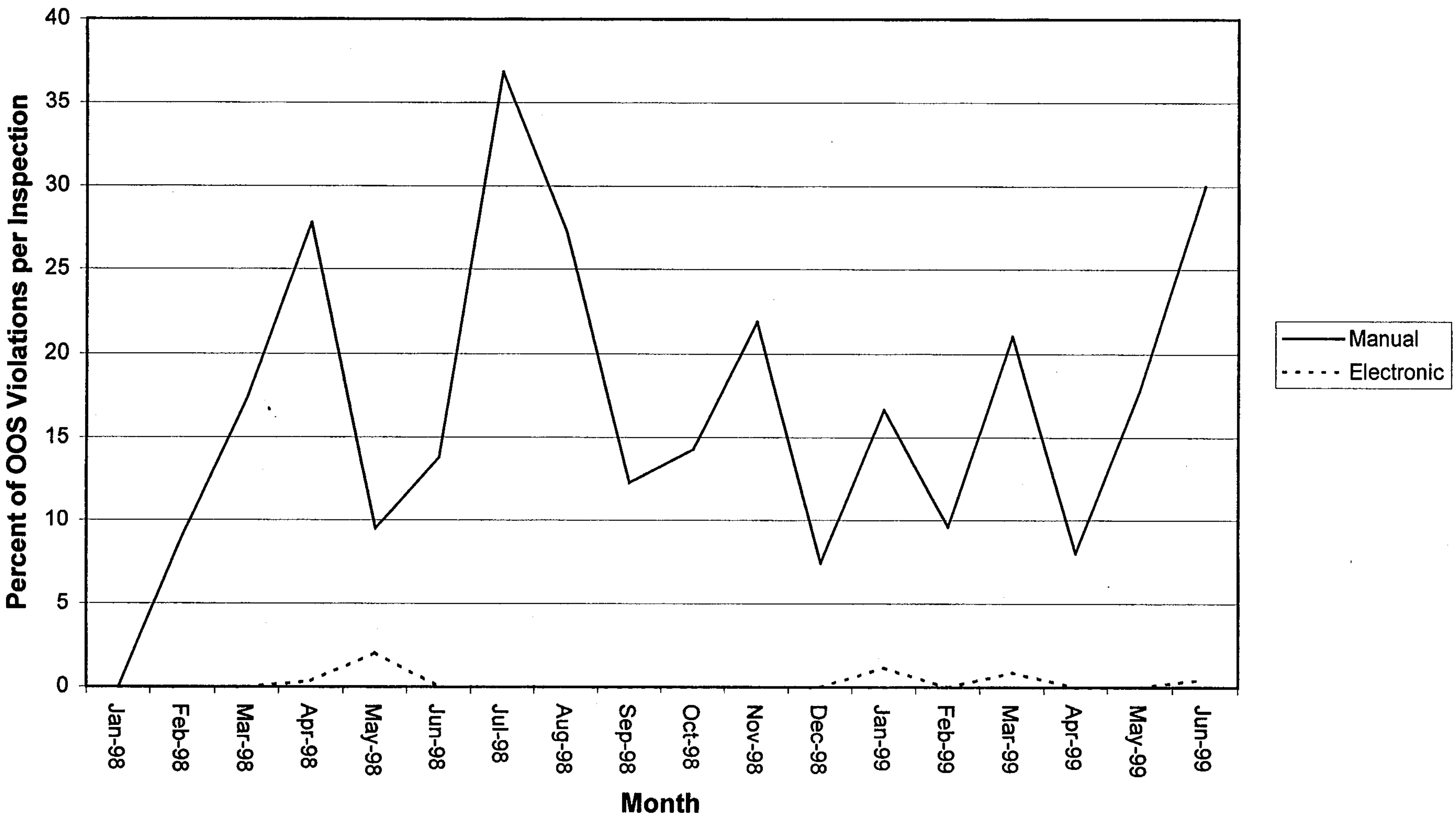


Figure 33: Percent of Inspections with Out-of-Service (OOS) Violations Cited (Level V).



3.4 TIMELINESS

Timeliness is measured in terms of the availability of safety inspection data to various stakeholders. Timeliness is important since it determines the availability of past inspection information to the weigh/inspection locations and other stakeholders. The inspectors can use the historical data to target high-risk carriers, vehicles, and drivers. Based on the processes depicted in Figure 2 for Maryland, timeliness has the four components described below.

The first component measures the availability of inspection data in electronic format. Manual inspection reports are keyed in by the MSP-C.V.E.D. office staff, while electronic inspection reports are keyed in by the inspectors at the site. The electronic inspection reports may either be uploaded to SAFER or mailed to the MSP-C.V.E.D. office on diskettes.

The second component measures the availability of inspection data on SAFETYNET. Electronic reports are downloaded through the Blizzard router before being integrated into SAFETYNET using the AVALANCHE software. This process was described in detail in Section 1.

The third component is the availability of inspection data on MCMIS, and the last component is the availability of inspection data on SAFER. Once the data are on SAFER, they are available to all jurisdictions and stakeholders. The analysis of the first three components is described next. The final component is still at the deployment and testing phase; hence, it is premature to evaluate it.

3.4.1 Availability of Inspection Data in Electronic Format

Figure 34 shows the average age of the manual and electronic inspection data in days from the date of inspection to the date when the MSP-C.V.E.D. personnel input the complete inspection report. Manual inspection reports are mailed by various jurisdictions to the MSP-C.V.E.D. office and then are keyed in by the data entry personnel. Electronic inspections are keyed in on-site by the inspectors. Hence, as observed, the input of electronic inspection reports occurs much earlier than for manual inspection reports. As observed in the figure, when compared to the last three months, electronic inspection reports for the prior months took longer. This is because before April 1999, electronic reports were stored on diskettes and then were either mailed or sent electronically to the MSP-C.V.E.D. office through the ASPEN-SAFETYNET link. Since April 1999, a majority of the inspection reports are uploaded to SAFER. The average age of manual data keyed in, for the 18 months duration, is 17 days, whereas the average age of the electronic data prior to uploading is only one day for the last three months. The average age is expected to be zero for the last three months since electronic inspections are expected to be keyed in the same day as the day of the inspection. The one-day delay is attributed to inspection reports that are not sent to SAFER on the day the inspection is conducted.

3.4.2 Availability of Inspection Data on SAFETYNET

The manual inspection reports are integrated into SAFETYNET by the MSP-C.V.E.D. office personnel, usually at the end of the day the data are keyed into the system. Electronic inspection reports are received in one of two machine-readable formats: on a diskette sent through mail or delivered by the inspector from the inspection location, or downloaded from SAFER using the Blizzard Router. The data are then prepared using the AVALANCHE software for integration into SAFETYNET.

Figure 35 shows the average age of the manual and electronic inspection data in days from the date of inspection to the date of data integration by the MSP-C.V.E.D. personnel into the SAFETYNET database. For the 18-month period, robust data are available only for the months October 1998 through June 1999. As seen from this figure, the average age of manual inspection data is generally higher than for electronic inspection data.

Figure 36 shows the average age in days from the date of input of the inspection report to the date of data integration into SAFETYNET. As can be observed, the average age of the electronic data is much higher when compared to the average age of the manual data for each of the nine months. The mean of the average age of the data integrated into SAFETYNET from the date of input for the nine-month period is 3.4 days for manual inspection reports. The corresponding value for electronic inspections for the last three-month period is 7.1 days. The three-month period is used for electronic inspections because before April 1999, electronic reports were stored on diskettes and were either mailed or sent electronically to the MSP-C.V.E.D. office using the ASPEN-SAFETYNET link. Since April 1999, a majority of the inspection reports are sent by various jurisdictions to SAFER. An MSP-C.V.E.D. office personnel then downloads these data from SAFER, prepares the data for integration, and then integrates the data into SAFETYNET. The late integration of the electronic data since the date of input is due to the fact that the electronic inspection data are uploaded to SAFER on an irregular basis. It should be noted that this value for electronic inspection data could be decreased significantly if the weigh/inspection facilities upload the data regularly, preferably at the end of each working day.

Overall, the average age of data from the date of inspection to the date of integration into SAFETYNET is 20.4 days for manual inspections and 8.1 days for electronic inspections.

3.4.3 Availability of Inspection Data on MCMIS

After the data from electronic and manual inspections have been integrated into SAFETYNET, they are uploaded to MCMIS. This is referred to as the first upload of inspection reports to MCMIS. Inspection data may need to be re-uploaded to MCMIS for several reasons. The most common reason for re-uploads is the addition of compliance information by carriers and/or drivers; this compliance information is obtained from inspection reports that are sent by the carrier and/or driver. Other reasons include errors and mismatches on inspection reports that are identified and corrected; these corrected reports need to be re-uploaded as described in Section 1.

3.4.3.1 First Upload of Inspection Data to MCMIS

Figure 37 shows the average age of the manual and electronic inspection data in days from the date of integration into SAFETYNET to the date data are first uploaded to MCMIS. Robust data are available only for the months of 1999. The initial date of upload to MCMIS is obtained from those inspections that have no violations and therefore will not result in a change in the upload date to MCMIS. Inspections with violations will result in overwriting the initial upload date with the re-upload date when the compliance information is re-uploaded to MCMIS. As expected, there is no observable difference in the average age of manual and electronic inspection data. The mean of the average age of the data uploaded initially to MCMIS from the date of integration into SAFETYNET for the six-month period is 5.2 days for manual inspection reports. The corresponding value for electronic inspections is 5.6 days.

Hence, the overall average age of manual and electronic inspection data from the date of inspection to the date they are first uploaded to MCMIS is 25.6 and 13.7 days, respectively. Therefore, electronic inspection data are uploaded approximately 12 days earlier than manual inspection data. Alternatively, this implies that it takes almost twice the amount of time to first upload manual inspection data to MCMIS when compared to electronic inspection data.

3.4.3.2 Last Upload of Inspection Data to MCMIS

Figure 38 shows the average age of the manual and electronic inspection data in days from the date of inspection to the date data are last uploaded (or re-uploaded) to MCMIS. There is no observable difference between the average age of manual and electronic inspection data uploaded to MCMIS. As discussed earlier, the process of compliance by carriers and/or drivers results in re-uploading the inspection data with the new compliance information. This overwrites the initial upload date with the new re-upload date. Compliance by carriers and/or drivers is independent of the mode of inspection data entry. Hence, as expected, the overall age of inspection data last uploaded to MCMIS is approximately the same for both manual and electronic inspections. It may be feasible to lower the overall age of electronic inspection data by allowing carriers and drivers to submit inspection compliance information electronically.

From the same figure, it appears that the overall age of inspection data is lower for the later months. However, it should be noted that these values might increase due to the late receipt of inspection compliance information from carriers and/or drivers.

The mean of the average age of the data last uploaded to MCMIS from the date of inspections for the 18-month period is 34.2 days for manual inspection reports. The corresponding value for electronic inspections is 35.7 days.

In conclusion, electronic inspection reports take approximately half the time since the date of inspection to be first uploaded to MCMIS as compared to manual inspection data. Re-uploads of inspection data to MCMIS, however, take the same time for both manual and electronic inspections.

3.4.4 Conclusion of Timeliness

Figure 39 shows the timeline of manual and electronic inspection data flow from the time of inspection to the last upload to MCMIS. The four components shown in this figure are as follows: i) the availability of inspection data in electronic format, ii) the availability of inspection data on SAFETYNET, iii) the availability of inspection data on MCMIS when first uploaded, and iv) the availability of updated inspection data on MCMIS. In order to compare these four components, it is assumed that an inspection is conducted on day zero.

As seen from the figure, the average time to input manual inspection data is significantly higher when compared to electronic inspection data. This is because the manual inspection reports are first mailed to the MSP-C.V.E.D. office and then keyed in at the office, whereas the electronic inspection reports are keyed in on-site by the inspectors. It should be noted that, for manual inspection reports, this component significantly adds to the delay in first uploading the inspection data to MCMIS.

On average, electronic inspection data are integrated into SAFETYNET approximately 3½ days later than manual inspection data. This is due to the fact that the electronic inspection data are uploaded to SAFER on an irregular basis. It should be noted that this delay can be significantly reduced if the weigh/inspection facilities upload the data regularly, preferably at the end of each working day.

The average time taken to first upload the inspection data into MCMIS after the data have been integrated into SAFETYNET is approximately the same for both manual and electronic inspections. However, manual inspection reports take approximately twice the time since the date of inspection to be first uploaded to MCMIS as compared to electronic inspection data. As noted earlier, this is mainly due to the delay in keying in the manual inspection data. Overall, the electronic inspection data are first uploaded to MCMIS approximately 12 days earlier when compared to the manual inspection data. Re-uploads of the inspection data to MCMIS take the same time for both manual and electronic inspections since this is largely dependent upon the carrier complying with the inspection. It may be feasible to lower the age of complied inspection data by allowing carriers and drivers to comply with the inspections electronically.

Figure 34: Average Age of Inspection Data Processed by the Maryland State Police Commercial Vehicle Enforcement Division (MSP-C.V.E.D.) Office.

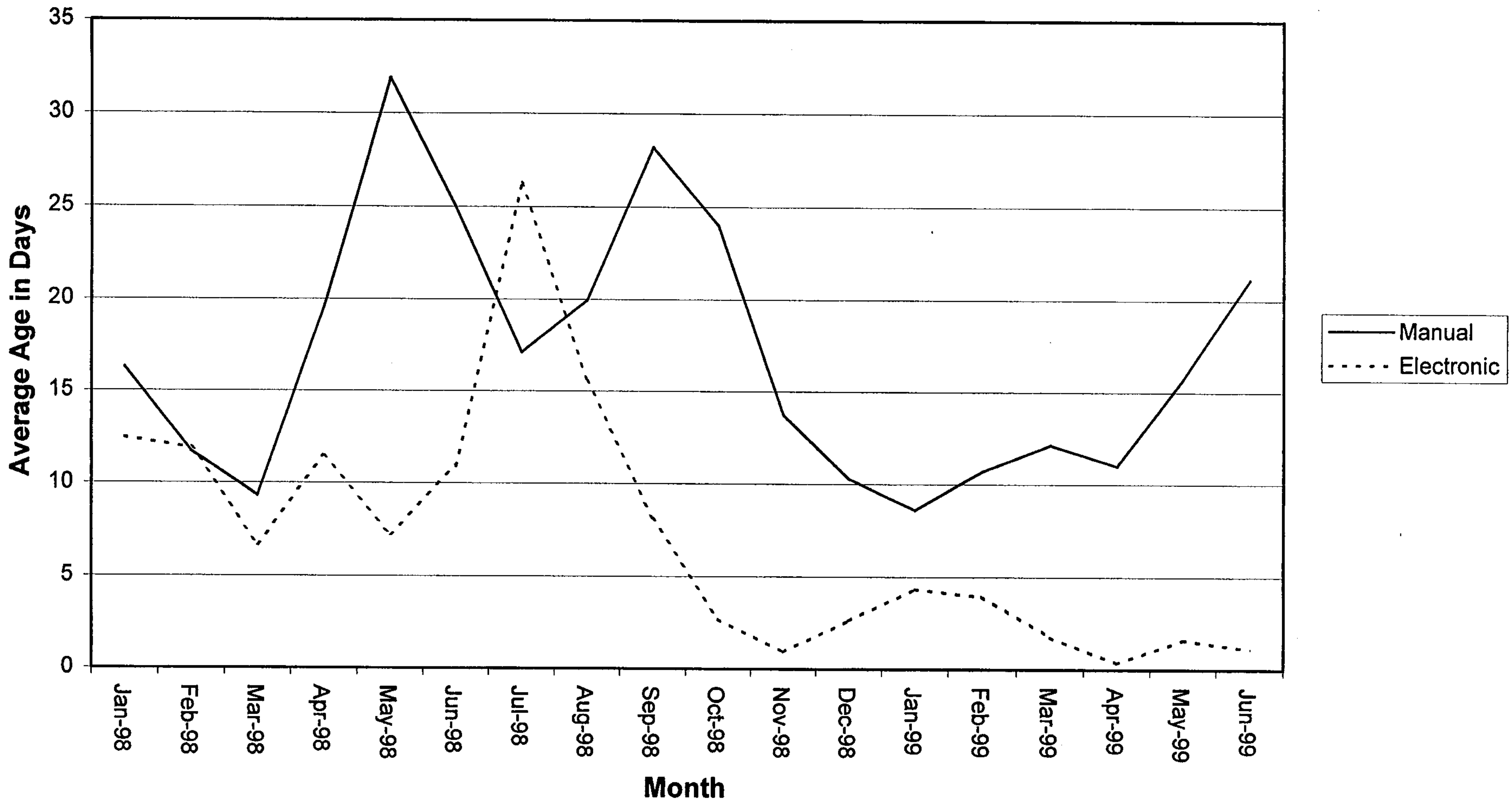


Figure 35: Average Age of Data When Uploaded to SAFETYNET Since Date of Inspection.

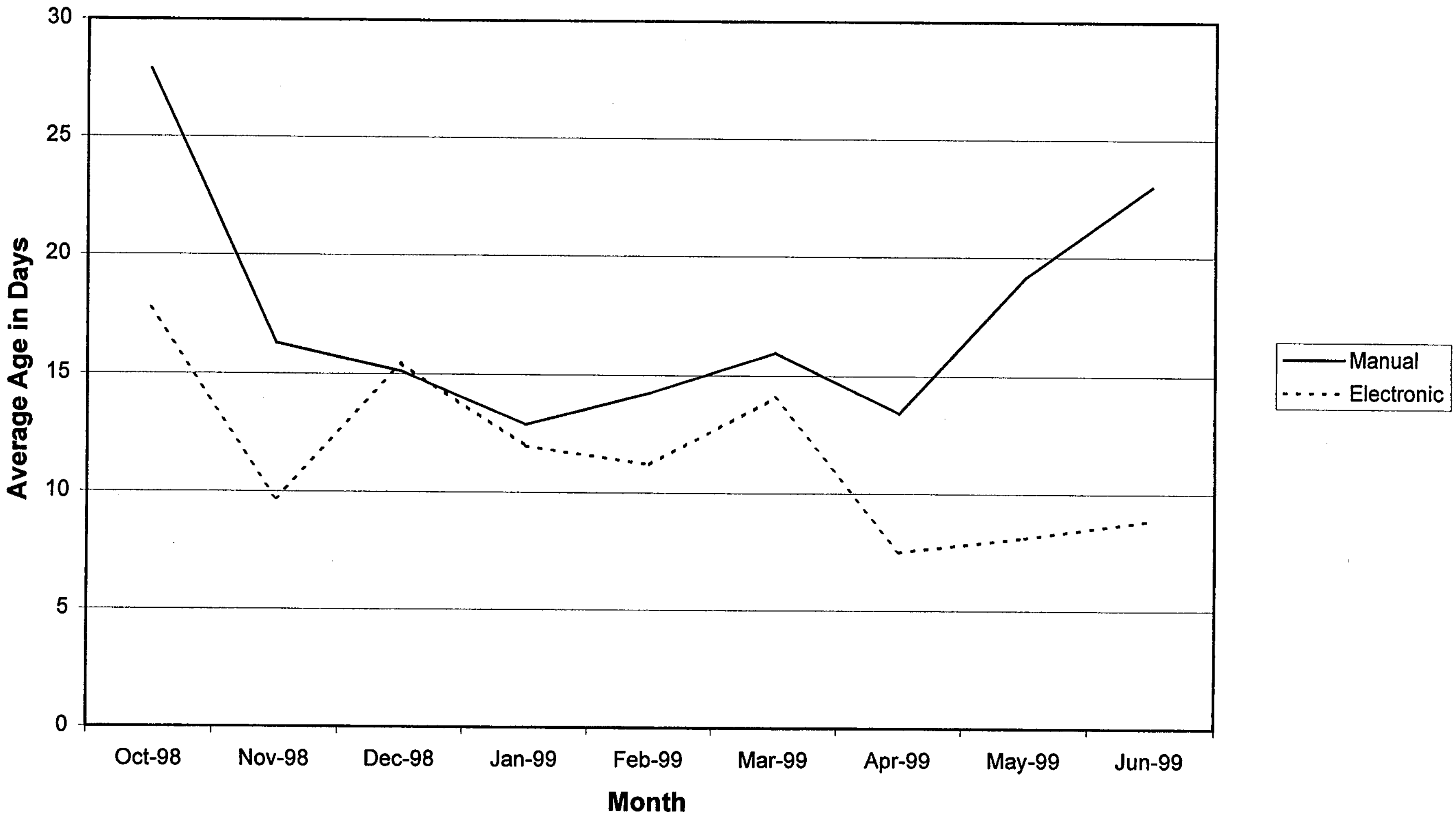


Figure 36: Average Age of Integrating Inspection Data into SAFETYNET Since Date of Input of Inspection Data.

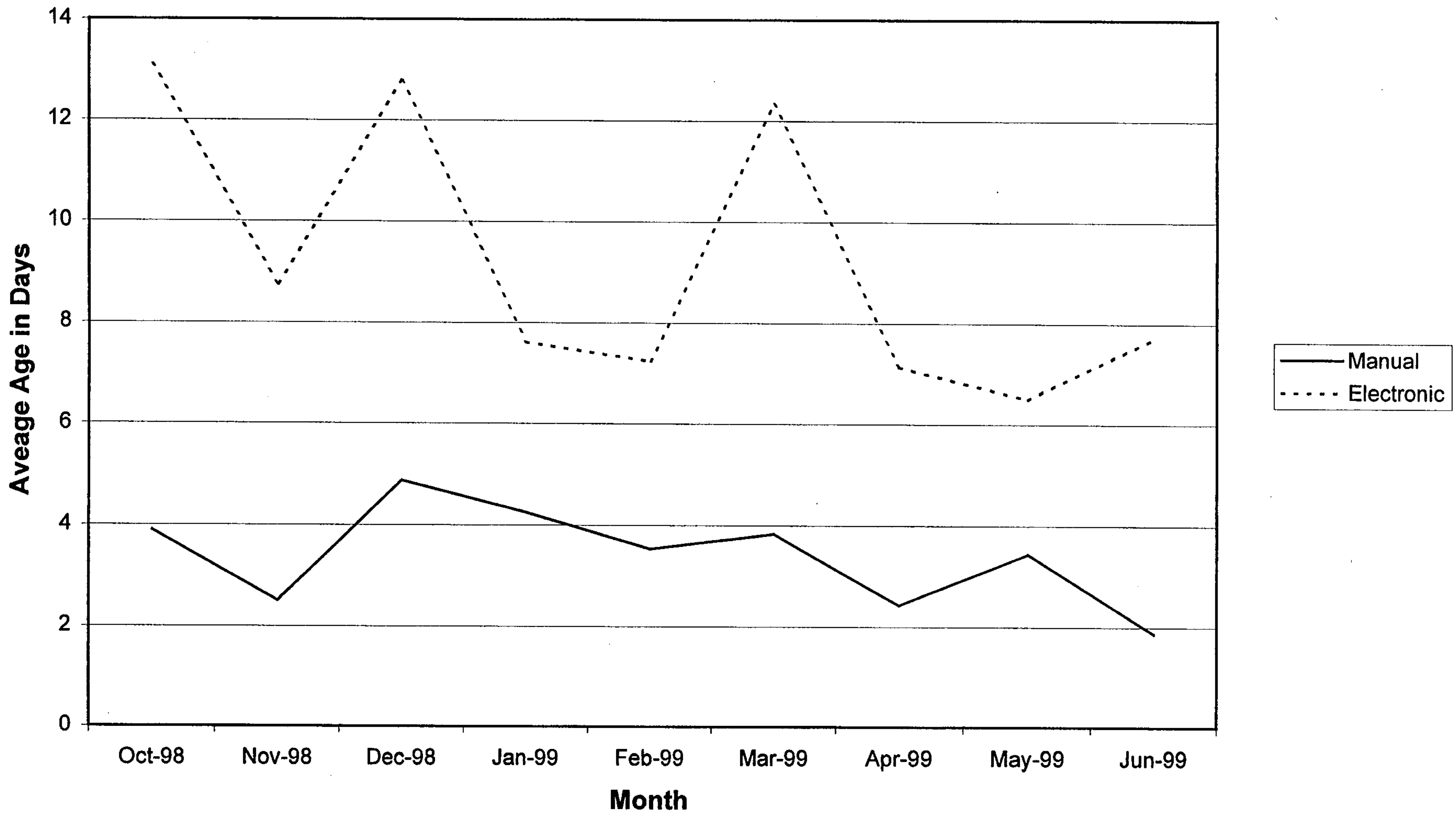


Figure 37: Average Date of Inspection Data When First Uploaded to MCMIS Since Integrating to SAFETYNET (In Days).

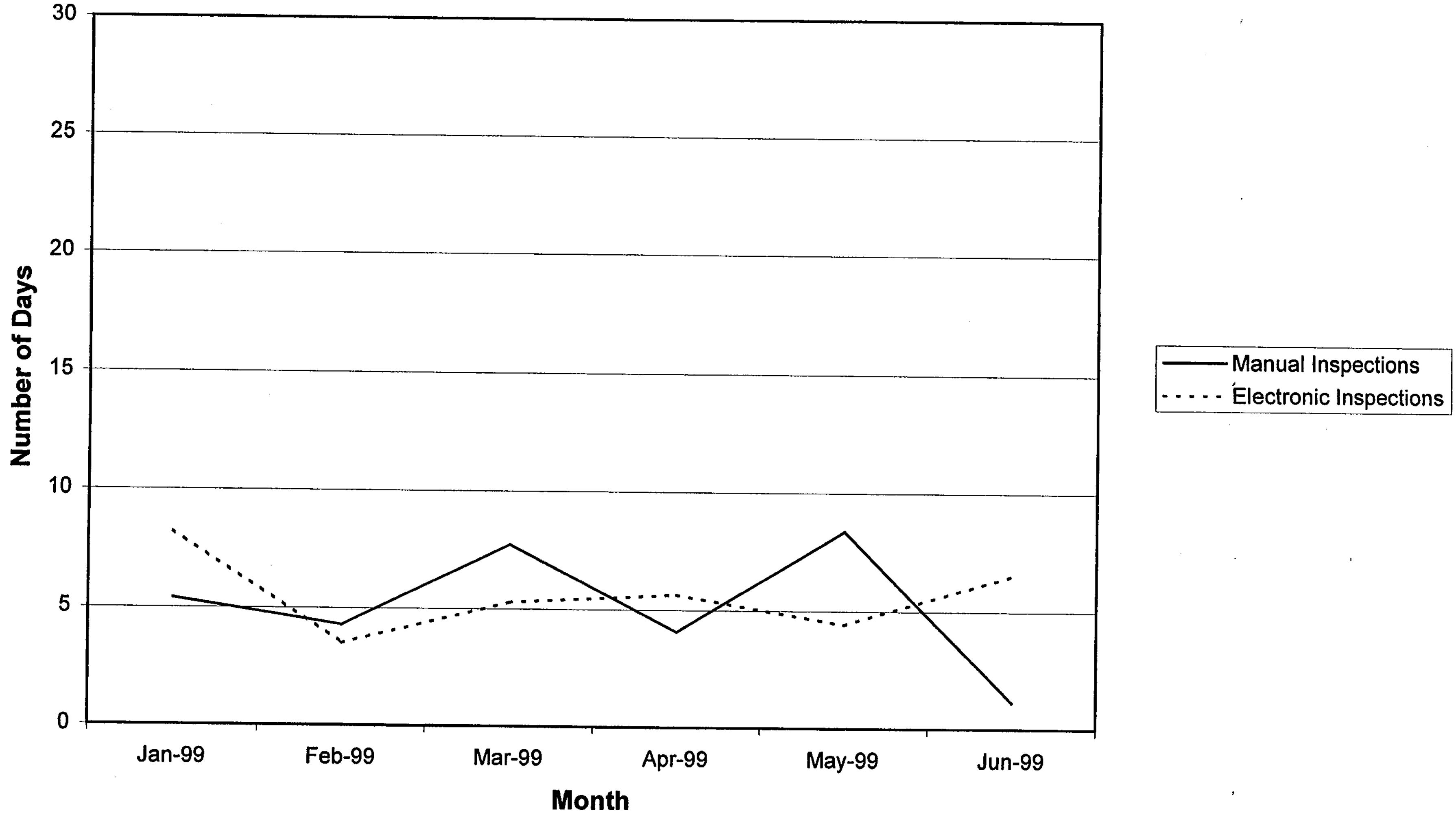


Figure 38: Average Age of Data When Last Uploaded to MCMIS Since Date of Inspection.

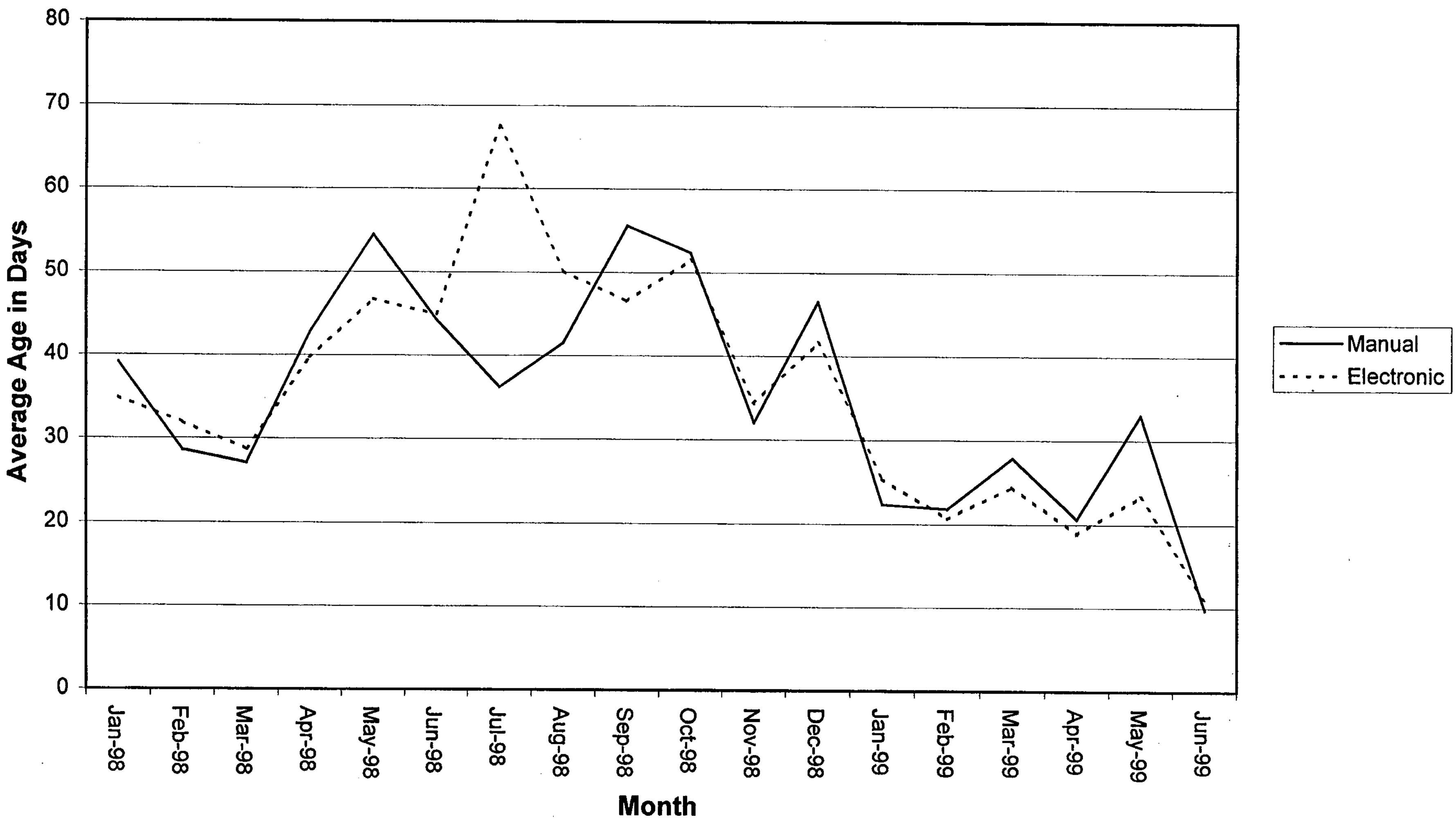
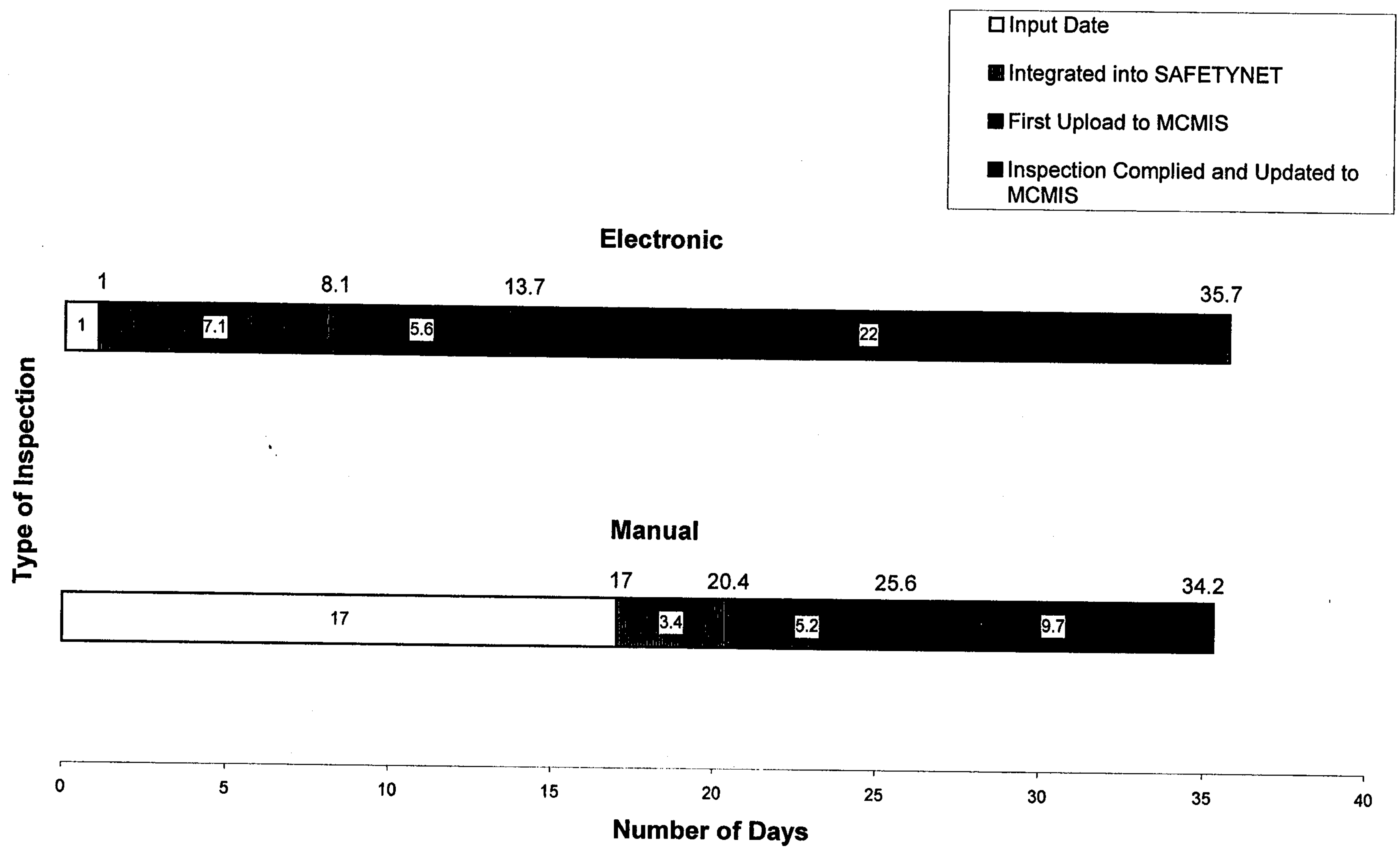


Figure 39: Time Components in Days for Flow of Inspection Data.



3.5 COMMERCIAL MOTOR VEHICLE DRIVER SURVEY AND ANALYSIS

The data documented and analyzed in this report are based on a survey administered through the National Transportation Center at Morgan State University. The major aim of the survey is to collect data on the perceptions of commercial vehicle drivers about roadside commercial motor vehicle and driver inspections conducted in Maryland. These inspections are conducted by inspectors at fixed roadside facilities located at selected locations on major highways and by roving crews on all other roads and highways. These inspections are conducted either manually or electronically (using ASPEN software and pen-based computers). Commercial vehicle drivers were asked about their perceptions on the objectivity and efficiency of these inspections. Additionally, the survey asked commercial vehicle drivers for their opinions regarding the legibility and clarity of the inspection report(s) given to them after the inspection.

The data for this survey were collected through numerous personal interviews of commercial motor vehicle drivers at several truck stop facilities in Maryland. These truck facilities are equipped with inns, restaurants, and other amenities that drivers can use to take a break from their trips. Hence, they were ideal locations where a maximum number of drivers could be contacted. The results and analysis of these personal interviews are reported in this document.

The results of this survey are important in assessing the user satisfaction component of the CVISN Safety Evaluation Study conducted by the National Transportation Center at Morgan State University. There were a total of 250 surveys printed and conducted. A total of 184 surveys are used for this analysis. Approximately 60 surveys could not be used for this analysis because the drivers indicated that they had not faced any roadside inspections in Maryland for a variety of reasons. A major reason was that drivers do not traverse in Maryland often and hence have not faced an inspection. Other reasons include driver avoidance of inspection facilities based on the fear that the inspection process takes too much time, is biased against drivers, and always results in a violation or citation. The rest of the surveys could not be used because of incomplete, ambiguous, and/or illegible information. The percentages in the following analysis are based on the total number of respondents to a given question.

Approximately 91% of the respondents indicated that they had been subject to at least one manual inspection in Maryland in the past two years, while approximately 33% of the respondents had experienced electronic inspections. This is due to the fact that only a few weigh/inspection facilities have the capability to conduct commercial vehicle and driver inspections electronically. The number of manual inspections for each of the respondents varied from 0 to 8, while the number of electronic inspections varied from 0 to 2. Tables 2 and 3 show the distribution of respondents for manual and electronic inspections, respectively.

Number of Manual Inspections	0	1	2	3	4	5	6	7	8
Number of Respondents	17	85	58	16	3	1	2	0	2

Table 2. Distribution of Respondents for Manual Inspections.

Number of Electronic Inspections	0	1	2
Number of Respondents	123	48	13

Table 3. Distribution of Respondents for Electronic Inspections.

Commercial vehicle drivers were asked to rate the objectivity and efficiency of manual inspections. Figure 40 shows that a majority of the respondents (99) found the process to be efficient, and 20 respondents perceived it as very efficient. However, 28 and 26 of the respondents perceived the inspection process as inefficient and very inefficient, respectively. Further, commercial vehicle drivers were asked to assess the clarity and legibility of the manual inspection reports that they received after the inspection. Figure 41 shows that a majority of the respondents (100) found the inspection reports to be clear, and 20 respondents consider them to be very clear. However, 27 and 26 of the respondents thought that the inspection reports were unclear and very unclear, respectively.

Commercial vehicle drivers who had experienced at least one electronic inspection were asked to rate the objectivity and efficiency of these inspections. Figure 42 shows that a majority of the respondents (39) found the inspections to be efficient, and 10 respondents perceived them as very efficient. However, only 8 and 3 of the respondents perceived the inspection process as inefficient and very inefficient, respectively. Further, respondents were asked to assess the clarity and legibility of the inspection reports that they received after the inspection. Figure 43 shows that a majority of the respondents (38) found the inspection reports to be clear and 17 respondents found them to be very clear. However, only 3 and 2 of the respondents thought that the inspection reports were unclear and very unclear, respectively.

Figures 44 to 46 give the data based on the actual number of respondents. However, as noted earlier, only 60 of the respondents had experienced electronic inspections as compared to the 173 respondents who had experienced manual inspections. Hence, we compare the commercial vehicle drivers' perceptions about the manual and electronic inspections and subsequent inspection reports based on the percentage of driver responses. Figure 44 shows that approximately 57% of the respondents perceive manual inspections to be objective and efficient, while 65% of the respondents perceive electronic inspections to be an objective and efficient process. Further, while only 12% of respondents perceive manual inspections to be very objective and efficient, approximately 17% of the respondents perceive electronic inspections to be objective and efficient. Additionally, while 15% of the respondents perceive manual inspections as very inefficient, only 5% of the respondents consider electronic inspections to be *very* inefficient.

Figure 45 compares the drivers' assessment of the clarity and legibility of the inspection reports for both types of inspections. As seen from the figure, approximately 58% of the respondents perceive the manual inspection reports to be clear and legible, while 63% of the respondents perceive the electronic inspection reports similarly. Further, while only 12% of the respondents perceive the manual inspection reports as being very clear and legible, 28% of the respondents have the same opinion for electronic inspection reports. Additionally, while 31% of the respondents perceive the manual inspection report as unclear or very unclear, only 8% of the respondents consider the electronic inspection reports to be unclear or very unclear.

Figure 46 shows the weighted average for the two criteria of a) objectivity and efficiency of inspections (measured on a scale of 0-3, with 0 being very inefficient and 3 being very efficient) and b) clarity and legibility of inspection reports (measured on a scale of 0-3, with 0 being very unclear and illegible and 3 being very clear and legible) for both types of inspections. As shown, in terms of objectivity and efficiency, manual inspections received an overall weighted score of 1.75, while electronic inspections scored 1.89. Similarly, in terms of clarity and legibility of inspection reports, handwritten reports had an overall weighted score of 1.79, while computer-generated reports scored 2.11. Hence, the survey data suggest that commercial vehicle drivers consider electronic inspections to be more objective and efficient than manual inspections. Additionally, respondents consider inspection reports produced electronically to be more clear and legible than inspection reports that are handwritten.

Figure 40: Objectivity and Efficiency of Manual Inspections Frequency of Responses.

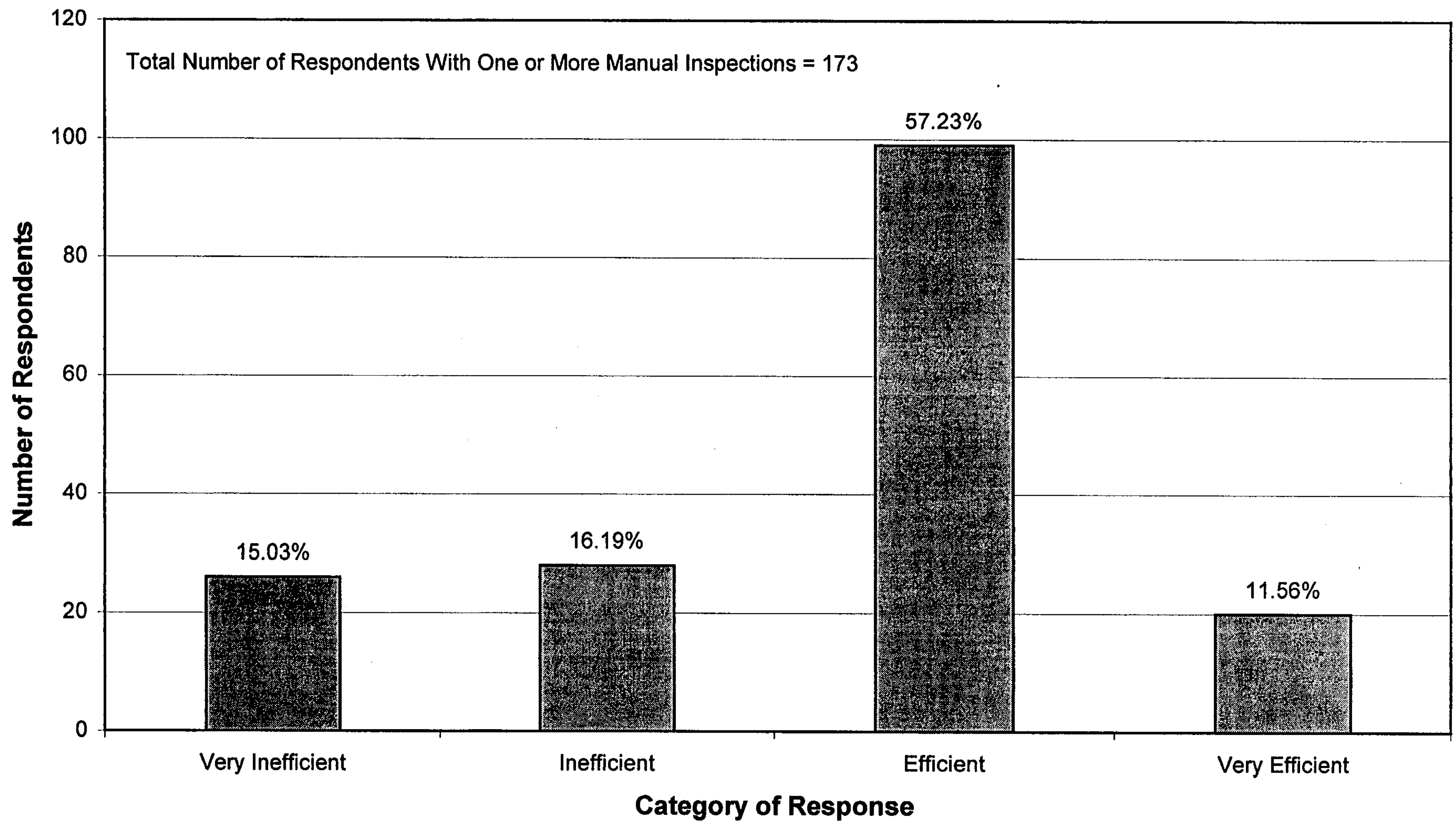


Figure 41: Clarity and Legibility of Manual Inspection Reports Frequency of Responses.

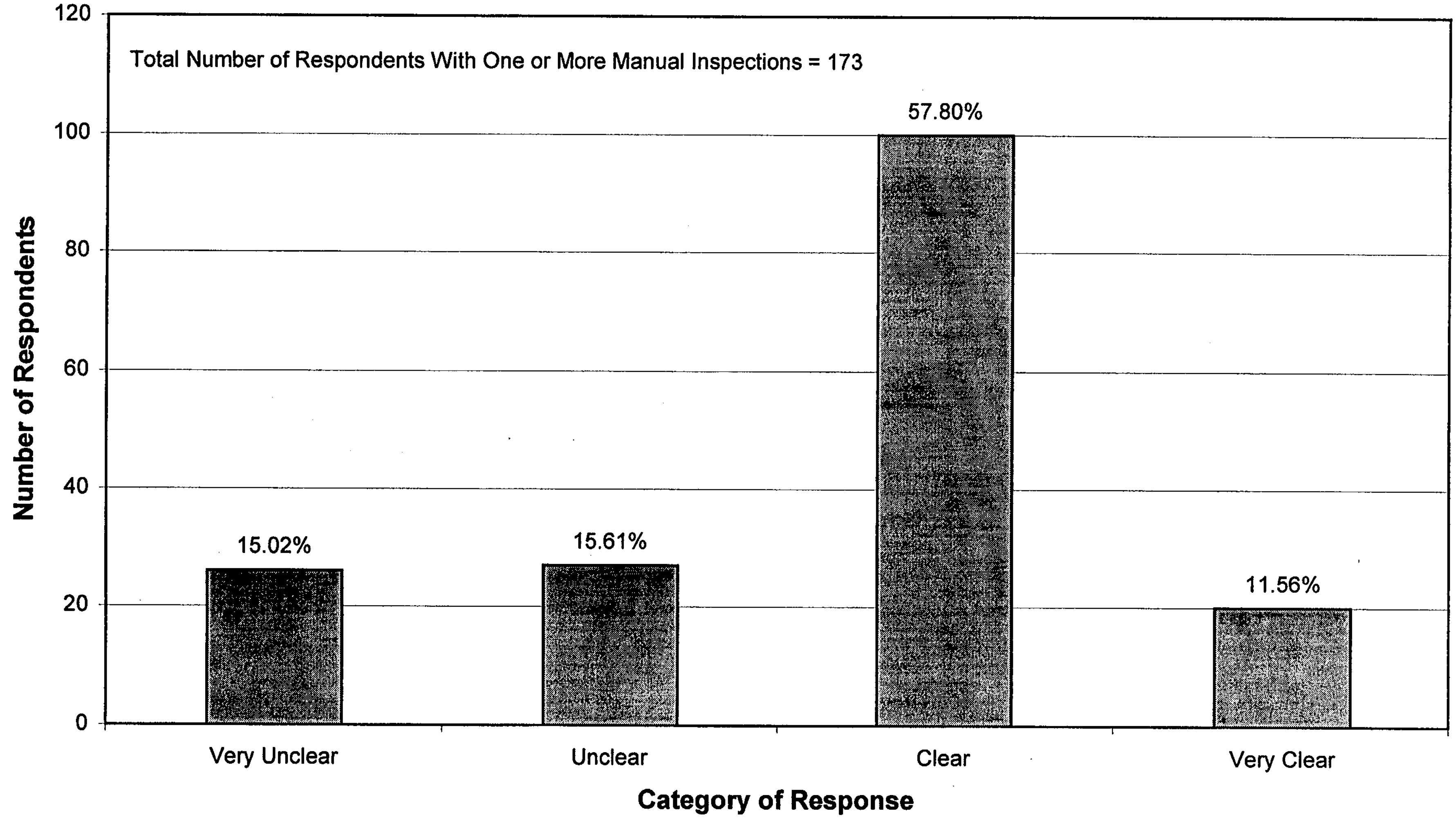


Figure 42: Objectivity and Efficiency of Electronic Inspections Frequency of Responses.

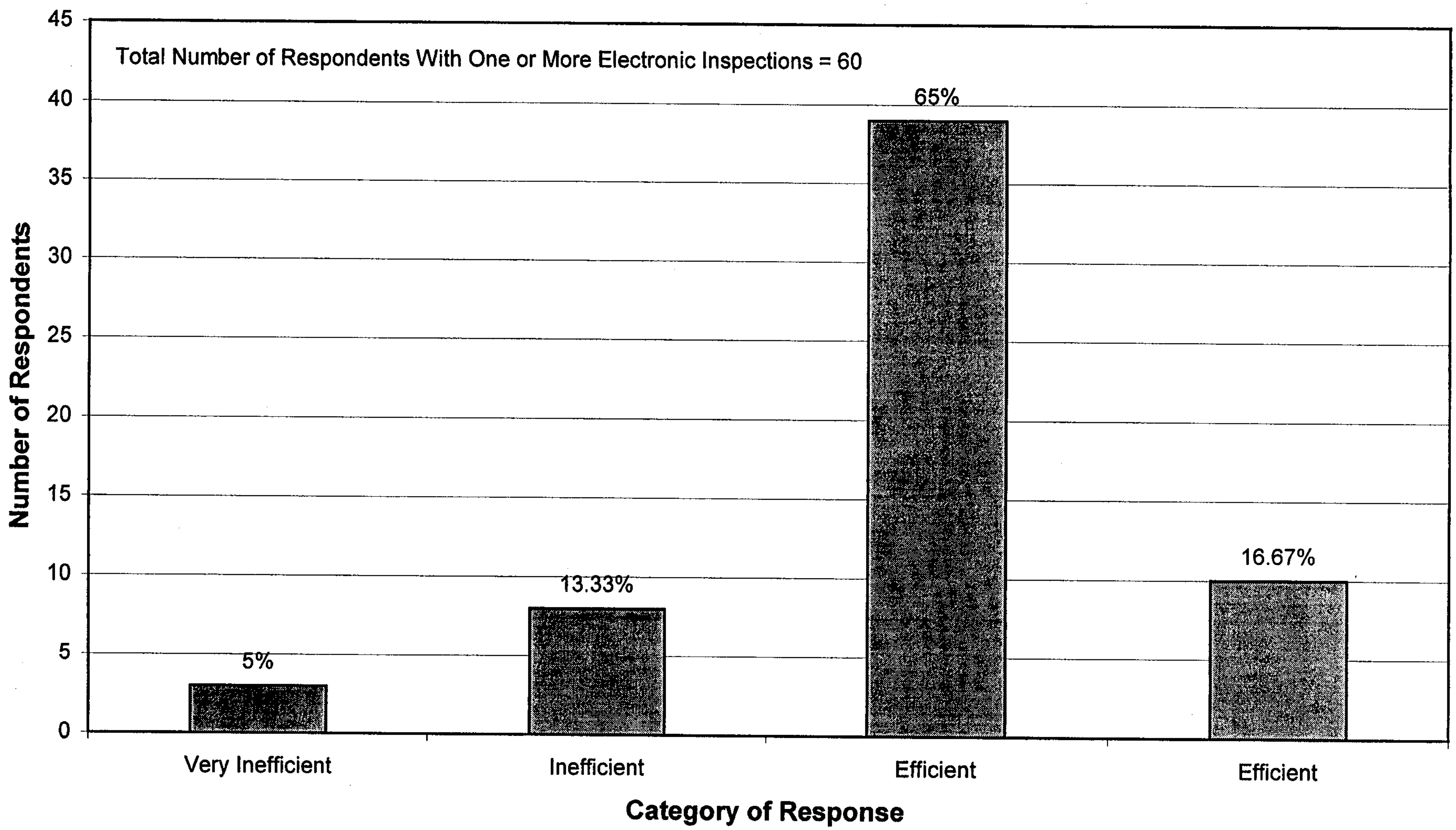


Figure 43: Clarity and Legibility of Electronic Inspection Reports Frequency of Responses.

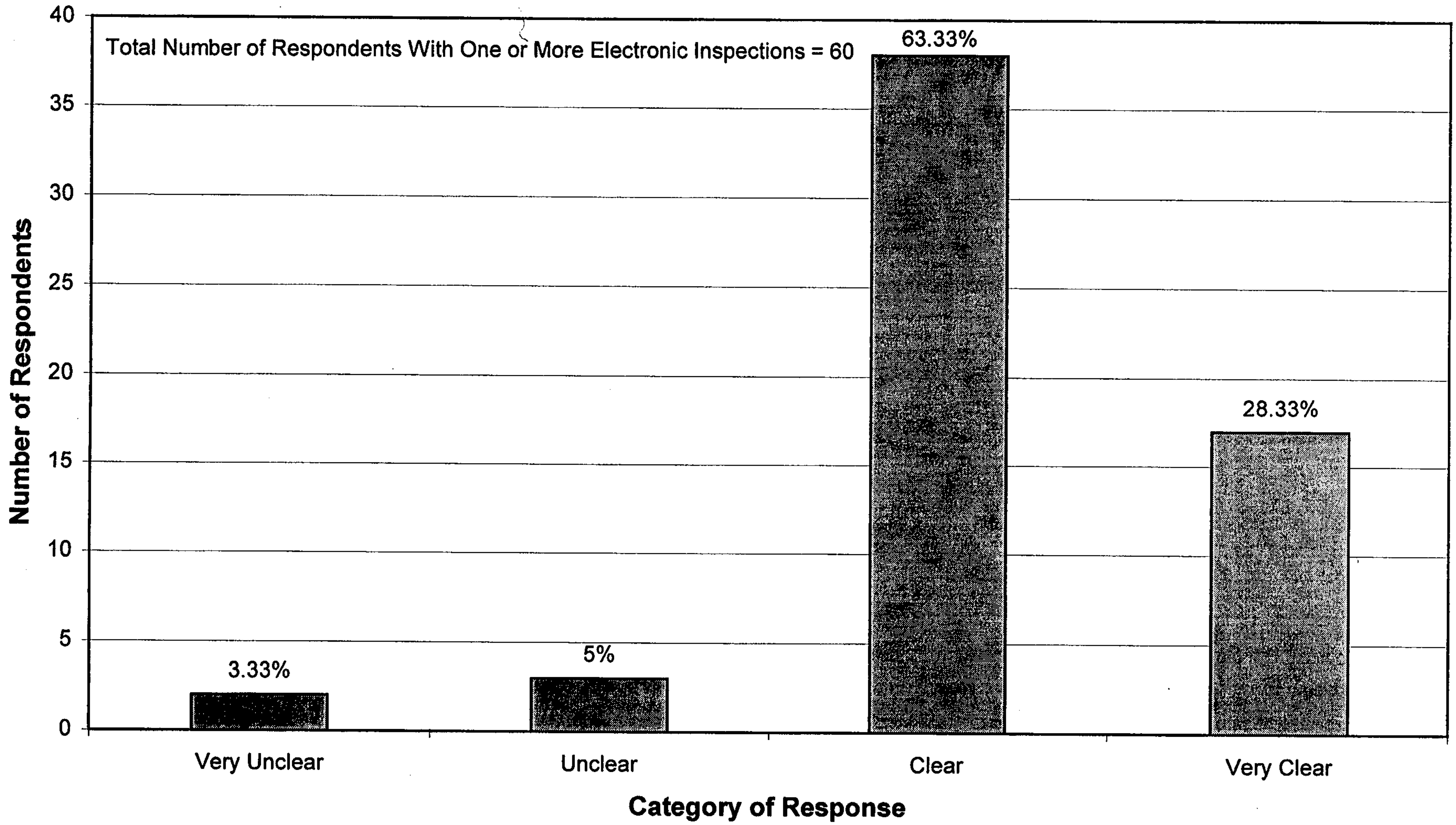


Figure 44: Objectivity and Efficiency of Inspections
Comparison of Responses for Manual and Electronic Inspections.

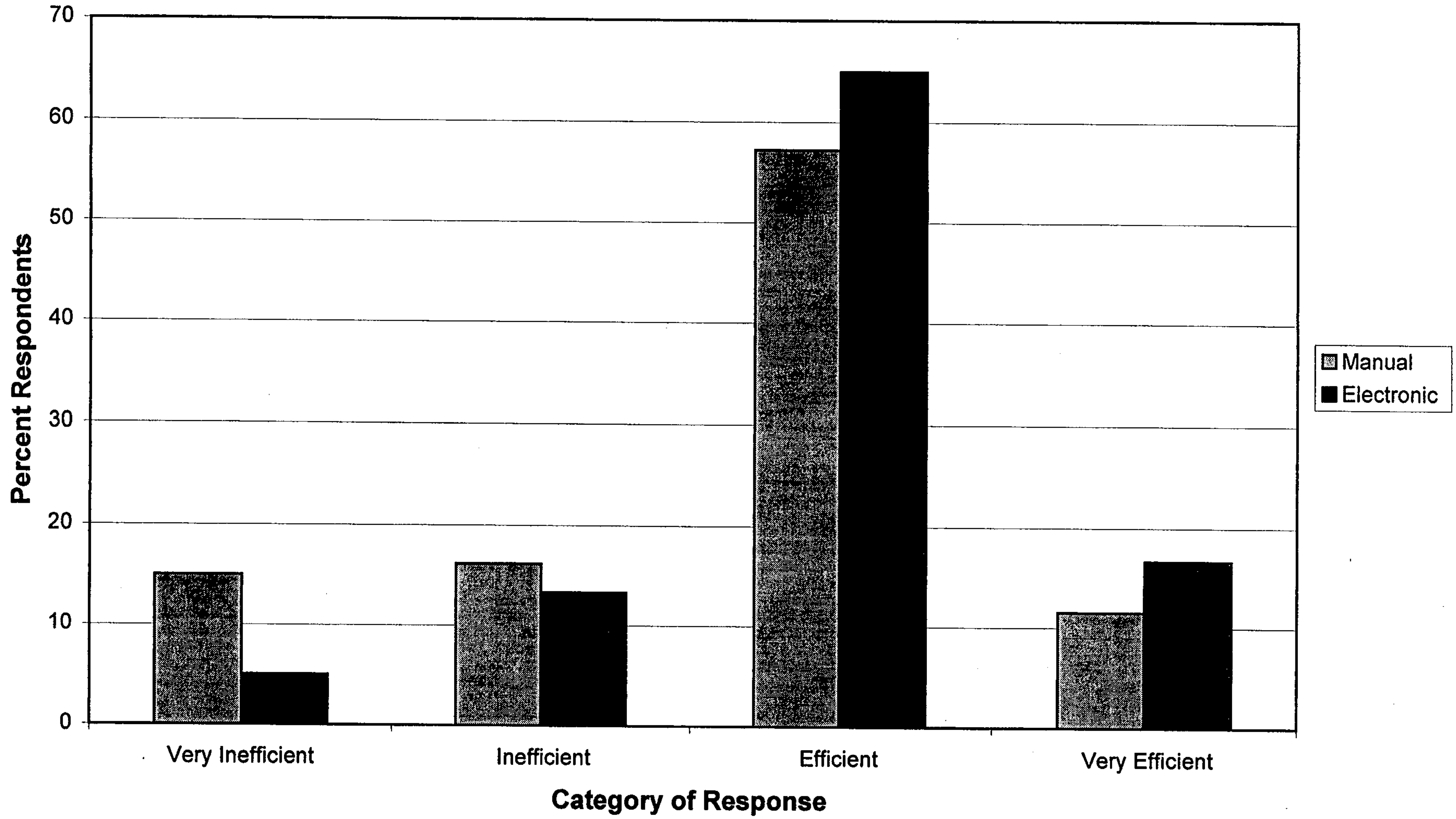


Figure 45: Clarity and Legibility of Inspections Comparison of Responses for Manual and Electronic Inspections.

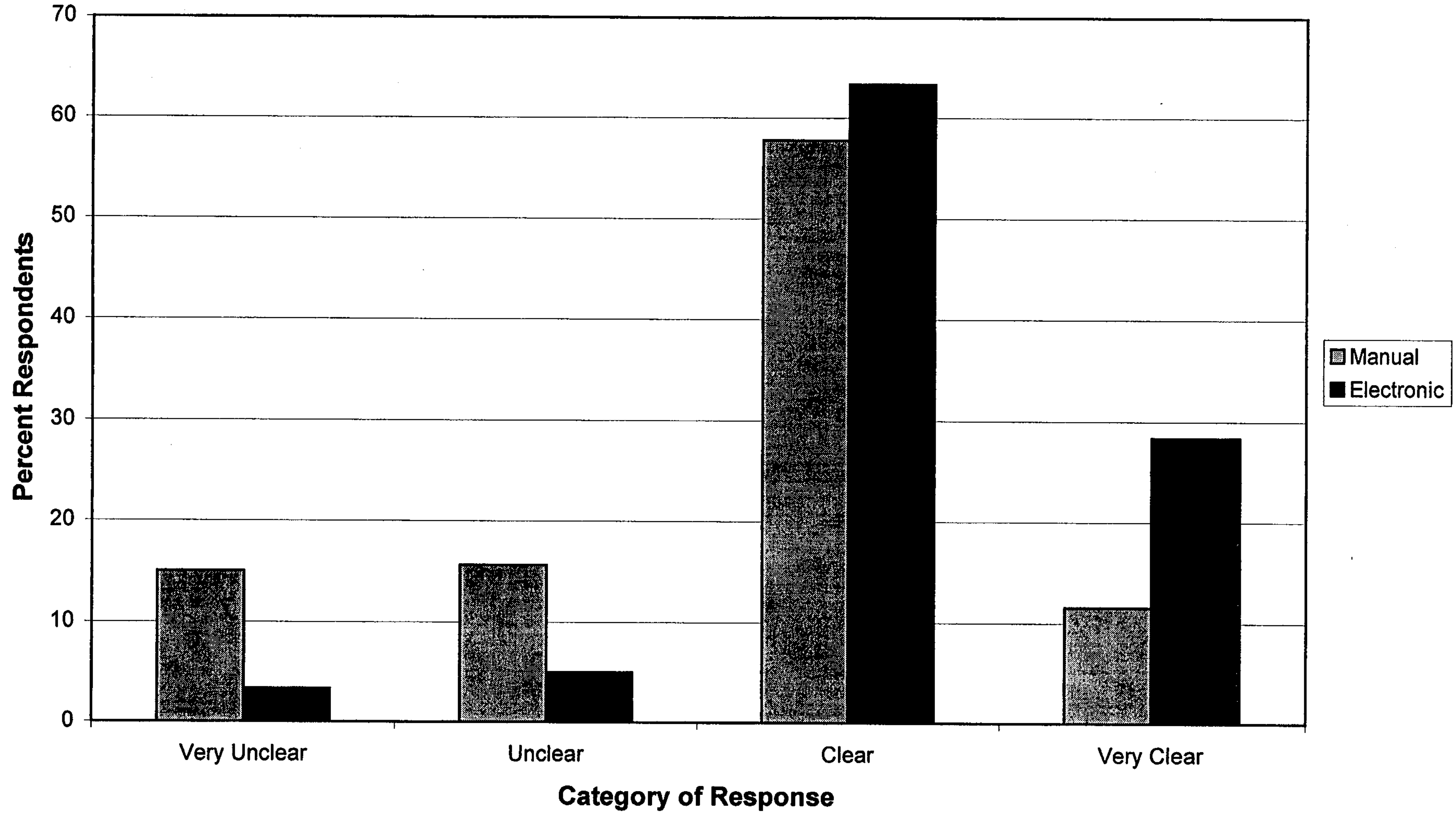
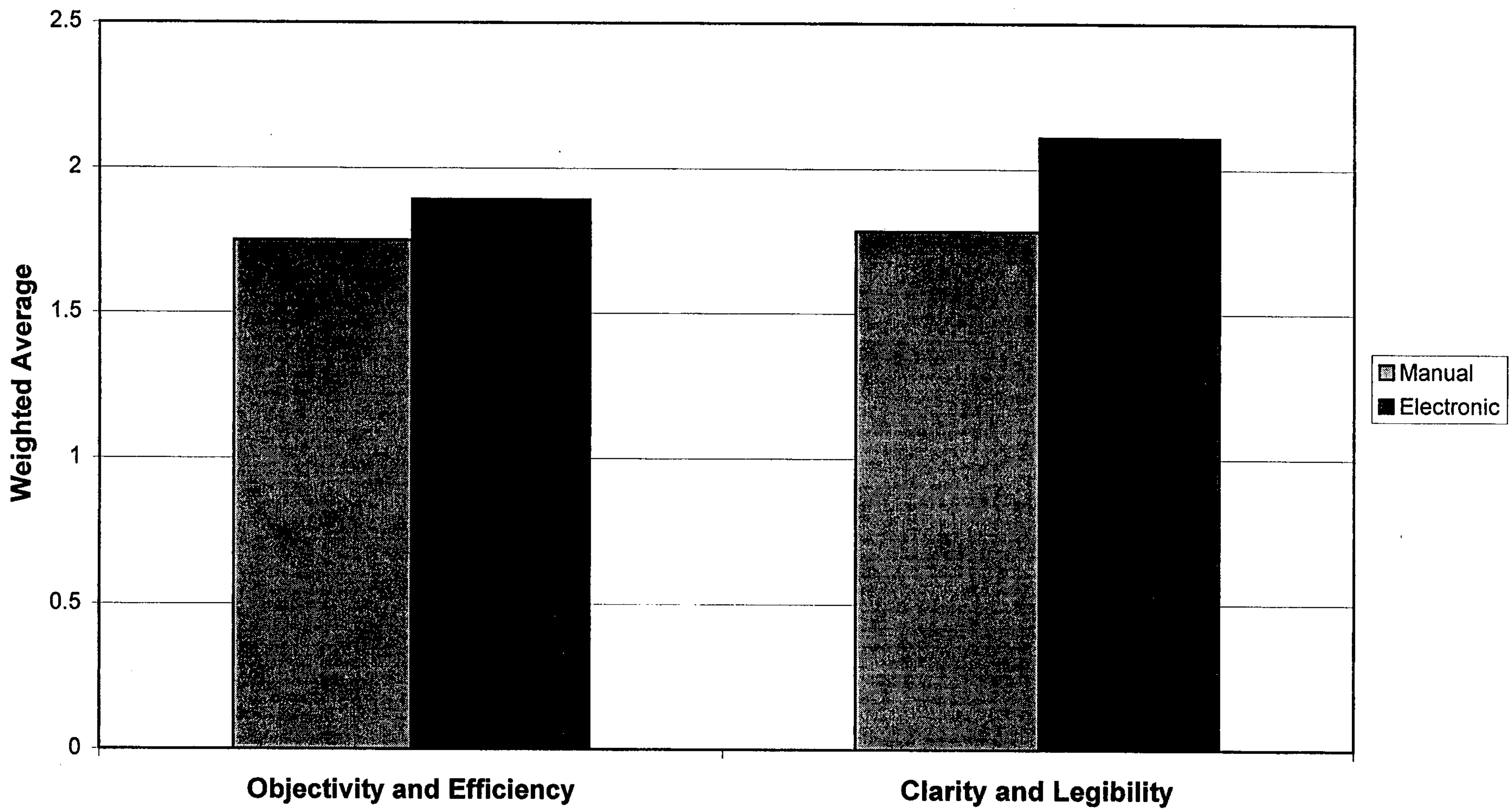


Figure 46: Weighted Averages for Objectivity and Efficiency of Inspections Clarity and Legibility of Inspection Reports.



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3.6 INSPECTOR SATISFACTION

Numerous studies have been carried out recently with respect to the inspector satisfaction of using electronic inspection systems. The two prominent studies for Maryland are the study conducted by CJI Research Corporation and the internal study done by MSP-C.V.E.D. This analysis summarizes the results of the focus group survey conducted by CJI Research Corporation for MSP-C.V.E.D. The analysis reports on anecdotal comments regarding the use and satisfaction with the ASPEN system. A detailed report of the survey responses is given in Appendix A.

Several inspectors took part in the focus group survey conducted on April 20,1999. Hugh Clark of CJI Research Corporation moderated the informal discussions in a round table format. Based on the results of these discussions, the following general conclusions can be made:

- Inspectors were initially apprehensive of using the electronic inspection system because of lack of computer knowledge and typing skills.
- The attitude of inspectors changes positively after they gain familiarity with the system.
- The inspectors are more appreciative of the advantages offered by the electronic inspection system.
- Although ISS helps in identifying high-risk carriers, and inspectors look at the ISS score, the inspectors do not rely on the ISS score completely.
- Inspectors identified numerous advantages of the electronic inspection system. Key advantages identified are reduction in the amount of time taken to prepare an inspection report, automatic verification of completeness of reports, and improvement in legibility and clarity of inspection reports.

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3.7 COMPLETENESS

This measures the completeness of the inspection reports written/entered by inspectors. Electronic inspection reports cannot be uploaded unless all mandatory fields are entered. Therefore, all electronic inspection reports are complete when uploaded. In contrast, an incomplete manual inspection report is identified when the MSP-C.V.E.D. data entry personnel key the data. This analysis reports on the percent of manually entered inspection reports that are incomplete.

Incomplete manual inspection forms are often corrected in the MSP-C.V.E.D. office in several ways that vary depending on the context of the missing information. The incomplete inspection forms may be checked on the basis of other information provided in the forms. Missing information can also be obtained by calling the respective authorities to recheck agency records or by sending the inspection forms back to the weigh station to the officer in charge of the inspection. Other sources of information include the Criminal Justice Information System (CJIS), which is used to get driver information.

To obtain the data, a survey was given to a MSP-C.V.E.D. data entry supervisor to provide the time taken for each of the activities. All of the data used in this analysis were obtained through actual measurements.

The completeness data were collected along with the data collected for evaluating the data upload efficiency. These data were obtained through observations of two data entry personnel performing the data entry task during a four-hour session. A total of 126 observations were taken. Of these observations, only one manual inspection report was incomplete. In conclusion, approximately less than one percent of the manual inspection reports are incomplete. This may be due to the fact that the MSP-C.V.E.D. office has programs in place whereby new inspectors are trained at the MSP-C.V.E.D. office and are made aware of the importance of filling out the inspection forms legibly and completely. Hence, the mode of manual inspection report entry does not currently result in a significant number of incomplete inspection reports in Maryland.

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3.8 ACCURACY

Accuracy measures the accuracy of the information entered on the inspection report. This analysis compares the percentage of non-matches of data for both electronic and manual inspections.

ASPEN-based as well as manual-based inspection reports can have two types of errors: data entry errors and inconsistency of data between Maryland's systems and the Federal Highway Administration's systems. Data entry errors are identified in the process of uploading the data to the SAFETYNET system. Several of these errors are corrected automatically by the SAFETYNET program. Where errors cannot be corrected, the C.V.E.D. office has to look up files or call up the weigh stations to correct the errors. Based on random data collected, the rate of occurrence of data entry errors is approximately 2.3% for ASPEN-based inspection data.

The inconsistency of data between Maryland's systems and the Federal Highway Administration's systems are referred to as non-match errors. An analysis was done on non-match database files obtained from the MSP-C.V.E.D. office to identify the percent of non-match errors for manual and electronic inspection reports. Figure 47 shows the percentage of these non-match errors for inspections conducted in Maryland during the period November 1998 to June 1999. Robust data for other months were not available. As shown in the figure, the total number of non-matches has been decreasing over the period. It should be noted that the low percentage of non-matches for the last three months could be due to the fact that several non-matches have yet to be reported. As can also be seen, a higher percentage of electronic inspection reports resulted in non-matches. Reasons for this include adjustment and changes to software and lack of training of inspectors. However, the percentage of electronic inspection reports resulting in non-matches reveals a noticeably decreasing trend.

Figure 48 shows the difference between the percentage of electronic and manual inspections that result in a non-match. As can be observed from the figure, the electronic inspection reports have more non-match errors compared to the manual reports. However, during the later months, the difference between the two has decreased markedly. This may be due to inspectors being made aware of the reasons for the non-match errors in electronic inspections and thus becoming more careful while entering inspection data.

This analysis is consistent with the analysis given by the office of the State Director for the Maryland Division of FHWA/OMCHS. According to that analysis, the percentage of Maryland's current non-match rate has dropped substantially during the 18-month period of our analysis.

Figure 47: Percent of Electronic and Manual Inspections Resulting in a Non-match Error.

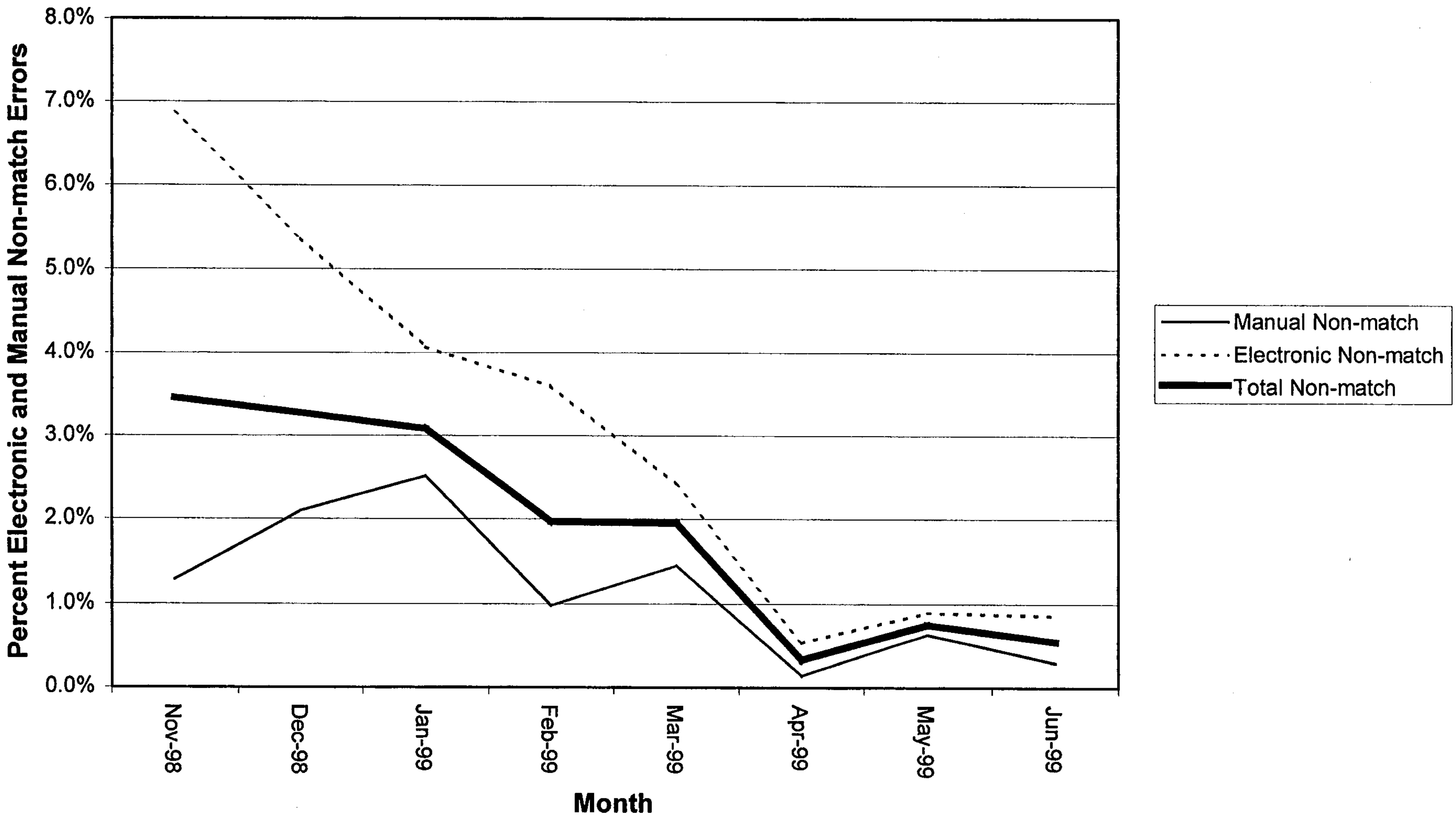
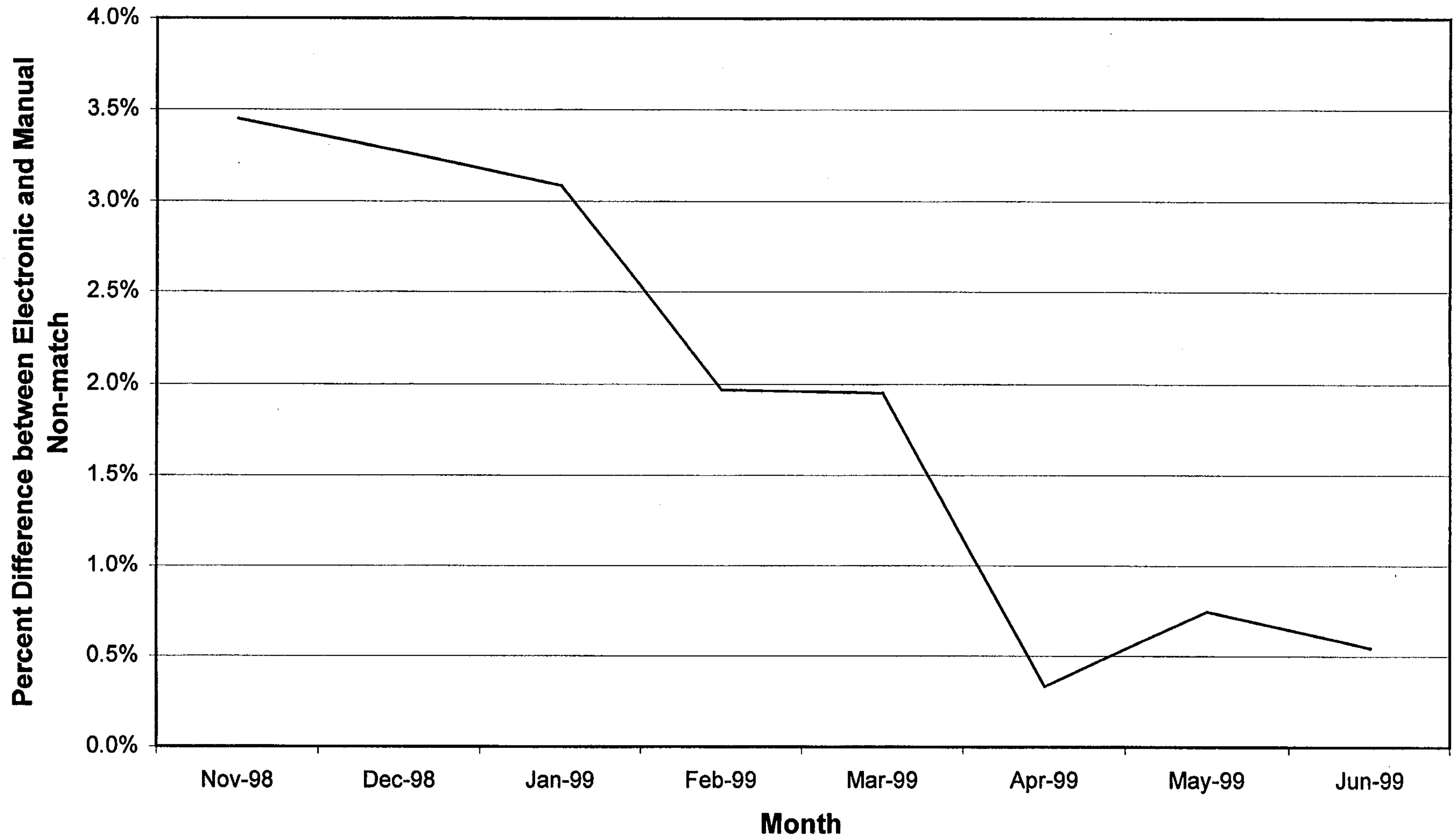


Figure 48: Difference between the Percentage of Electronic and Manual Inspections Resulting in Non-match Errors.



3.9 DATA UPLOAD EFFICIENCY

Data upload efficiency measures the time taken by the MSP-C.V.E.D. personnel to enter and upload inspection data to SAFETYNET. This analysis compares the efficiency for uploading inspection data for both manual and electronic inspections.

All inspection reports are uploaded to SAFETYNET in the MSP-C.V.E.D. office. The time to upload the data depends upon the mode of inspection. For manual inspections, the data upload time is composed of three components: the time taken to enter the data, the time taken to check for data entry errors using Inspect Check, and the time taken to re-merge the data into SAFETYNET. For electronic inspections, the data upload time is the time taken to download the data from SAFER, unzip and reformat the data, and integrate these data into SAFETYNET.

To obtain the data, a survey was given to MSP-C.V.E.D. data entry supervisors to provide the time taken for each of the activities. All of the data used in this analysis were obtained through actual measurements. The upload times for manual and electronic inspections are provided below.

3.9.1 Manual Inspections

Manual Inspection Reports Upload Time =

Time taken to keyin data +

Time taken to perform the inspect check +

Time taken to re-merge and integrate data into SAFETYNET

The time taken to keyin the data was obtained through observations of two data entry personnel performing the data entry task during a four-hour session. A total of 126 observations were taken. Figure 49 shows the distribution of the time taken to enter the manual inspection reports. As seen from the figure, the majority of inspection reports were keyed in less than 90 seconds. The average time taken to keyin the inspection data was 80.5 seconds.

The time taken to perform the inspect-check and re-merge of data into SAFETYNET was obtained from the data entry supervisor. These two activities are performed in batches of approximately 250 inspections, or one day's data entry work at MSP-C.V.E.D.. The time taken for inspect check was 5 minutes per batch, and the time taken to re-merge and integrate the data into SAFETYNET was 7.50 minutes per batch. Hence, the time to keyin data for this batch is 335 minutes (80.5 seconds/inspection report * 250 inspections).

Therefore,
Manual Inspection Reports Upload Time/ batch = 335 + 5 + 7.5 = 347.5 minutes/batch.
This time does not include the time to correct and process errors in manual reports and other administrative activities.

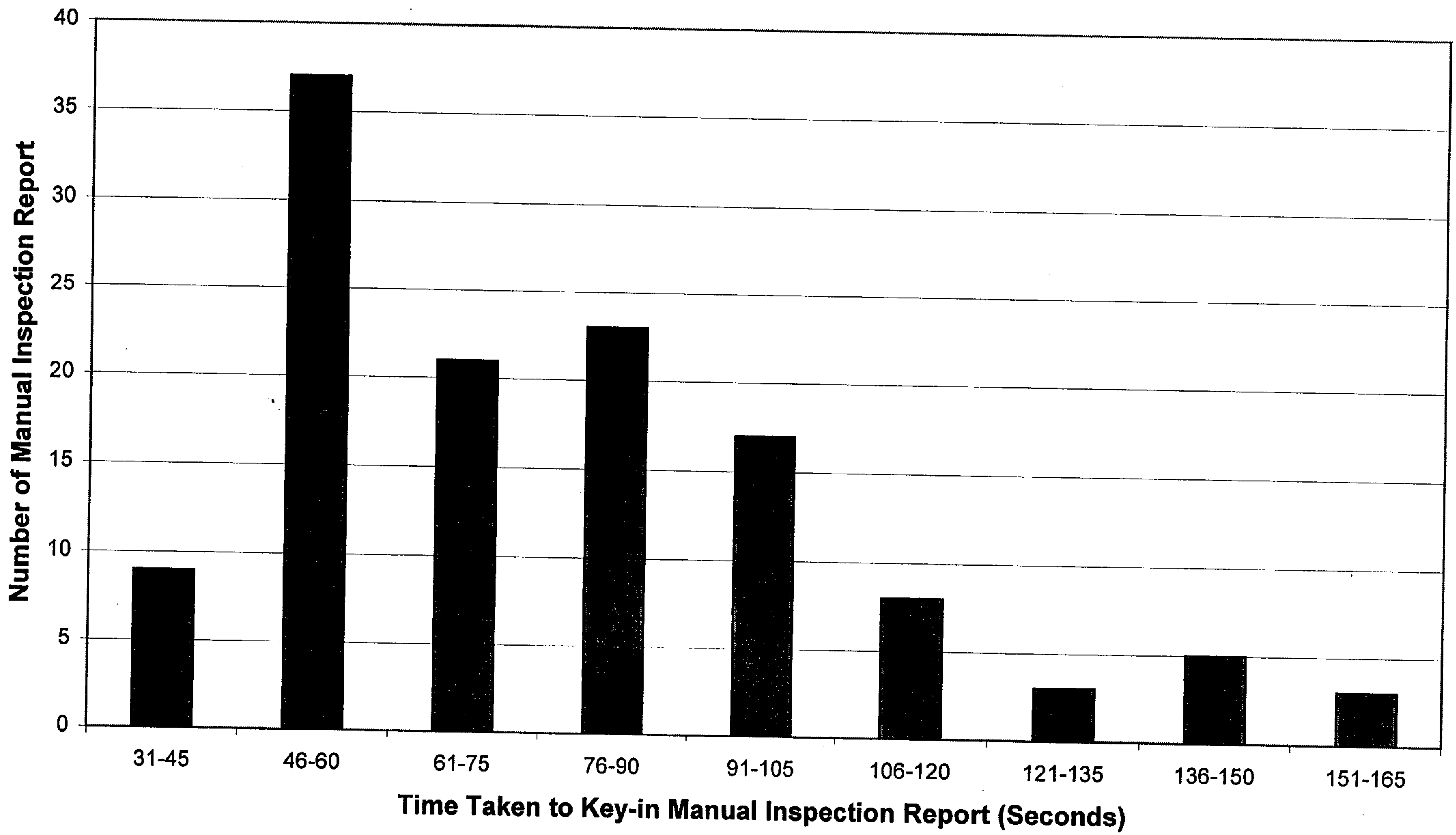
3.9.2 Electronic Inspections

For electronic inspections, the data upload time is the total time taken to download the data from SAFER, unzip and reformat the data, and integrate these data into SAFETYNET. The total time taken for all these activities was obtained from the data entry supervisor. These tasks are performed in batches, usually at the end of the day. The manual time taken for all of these activities per batch is independent of the number of electronic inspection reports processed. This is because all the activities are automated.

Based on measurements by data entry supervisor,
Electronic Inspection Reports Upload Time = 18 minutes/batch.
This time does not include the time taken to correct and process errors in electronic reports and other administrative activities.

In conclusion, electronically entered inspection reports are uploaded significantly faster when compared with manual inspection reports. This is mainly because manual reports have to be keyedin while electronic reports are downloaded.

Figure 49: Frequency Distribution of the Time Taken to Key in Manual Inspection Reports.



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4.0 CONCLUSION

CVISN system deployments are expected to necessitate, and otherwise facilitate, changes in the operational processes of the participants. The purpose of this document was to complete an evaluation study and provide a report on the post-implementation results of CVISN safety information exchange and roadside operations that will enable policy makers and commercial vehicle administrators to objectively assess the outcomes of the CVISN implementations. Safety information exchange includes distribution of safety information to and from computers at the roadside, while roadside operations include electronic collection of inspection data. This study examined the following safety-related activities:

- Electronic collection of inspection data at roadside inspection facilities;
- Transmission of inspection data from roadside inspection facilities;
- Distribution of safety information to computers at the roadside.

Section I described the CVISN safety assurance system components, the links between the components, and the related processes. Section II discussed in detail the evaluation criteria, data sources used to measure the evaluation criteria, and the results of the analysis for the safety-related activities mentioned above.

Based on the evaluation criteria identified for both electronic and manual inspections, the following conclusions can be made.

4.1 THROUGHPUT OF COMMERCIAL VEHICLES BEING INSPECTED

The total number of electronic inspections has increased steadily from approximately 6% of the total in January 1998 to nearly 50% in June 1999. Additionally, a higher fraction of semi trailers are being inspected electronically when compared to the proportion of straight trucks.

4.2 EFFICIENCY OF COMMERCIAL VEHICLE AND DRIVER INSPECTIONS IN MARYLAND

Efficiency was measured as the time taken to conduct an inspection. Electronic inspections showed a trend towards increased efficiency. This analysis could not prove that electronic inspections are indeed more efficient compared to manual inspections. This can only be substantiated when similar data are captured and analyzed for the coming months.

Electronic inspection systems have not been fully deployed, and it is possible that the learning curve phenomenon may still be influencing the average time taken for conducting inspections. Once the electronic inspection systems have been fully deployed and used, then it is anticipated that further efficiency gains can accrue as the influence of the learning curve phenomenon diminishes.

4.3 EFFECTIVENESS OF COMMERCIAL VEHICLE AND DRIVER INSPECTIONS IN MARYLAND

For inspection systems, effectiveness was measured in terms of the number of violations cited at weigh/inspection facilities and by roving crews in Maryland. Measures of effectiveness used were the average number of violations cited per inspection and the percent of inspections that result in a violation(s) being cited. Violations were grouped into the following two types: violations that do not result in a vehicle/driver being placed out-of-service (OOS), and violations that result in either the vehicle and/or the driver being placed OOS. For both types of violations, more violations were cited a) per electronic inspection, b) at Level I, and c) for straight trucks. Moreover, the percent of inspections resulting in one or more violations cited was higher a) for electronic inspections, b) at Level I, and c) for straight trucks. For Level V inspections, a significantly higher percent of manual inspections results in violations with citations.

4.4 TIMELY AVAILABILITY OF SAFETY INSPECTION DATA

The four components evaluated were i) the availability of inspection data in electronic format, ii) the availability of inspection data on SAFETYNET, iii) the availability of inspection data on MCMIS when first uploaded, and iv) the availability of updated inspection data on MCMIS. The average time to input manual inspection data was significantly higher compared to electronic inspection data. For the 18-month duration, the average age of manual data keyed in was 17 days, whereas the average age of the electronic data prior to uploading was only one day for the last three months when the SAFER mailbox was being used. This is because the manual inspection reports are first mailed to the MSP-C.V.E.D. office and then keyed in at the office, whereas the electronic inspection reports are keyed in on-site by the inspectors. It should be noted that, for manual inspection reports, this component significantly adds to the delay in first uploading the inspection data to MCMIS.

On average, electronic inspection data were integrated into SAFETYNET approximately 3½ days later than manual inspection data. This is due to the fact that the electronic inspection data are uploaded to SAFER on an irregular basis. It should be noted that this delay can be significantly reduced if the weigh/inspection facilities upload the data regularly, preferably at the end of each working day.

The average time taken to first upload the inspection data into MCMIS after the data have been integrated into SAFETYNET was approximately the same for manual and electronic inspections. However, manual inspection reports took approximately twice as long since the date of inspection to be first uploaded to MCMIS as compared to electronic inspection data. This was mainly due to the delay in keying in the manual inspection data. Overall, the electronic inspection data were first uploaded to MCMIS approximately 12 days earlier when compared to the manual inspection data. Re-uploads of the inspection data to MCMIS took the same time for both manual and electronic inspections since this was largely dependent upon the carrier complying with the inspection. It may be feasible to lower the age of complied inspection data by allowing carriers and drivers to comply with the inspections electronically.

4.5 DRIVER SATISFACTION WITH THE INSPECTION PROCESS

Drivers reported that the electronic inspection process was marginally more objective and efficient when compared to the manual inspection process. However, drivers perceived that the electronic inspection reports were significantly more legible and clear than manual inspection reports.

4.6 INSPECTOR SATISFACTION WITH THE INSPECTION PROCESS

Inspectors identified numerous advantages of the electronic inspection system. Key advantages identified were reduction in the amount of time taken to prepare an inspection report, automatic verification of completeness of reports, and improvement in legibility and clarity of inspection reports. However, inspectors were initially apprehensive about using the electronic inspection system because of lack of computer knowledge and typing skills.

4.7 COMPLETENESS OF INSPECTION REPORTS

Electronic inspection reports cannot be uploaded unless all mandatory fields are entered and are hence complete. Approximately less than one percent of the manual inspection reports were incomplete. This may be due to the fact that the MSP-C.V.E.D. office has programs in place whereby new inspectors are trained at the MSP-C.V.E.D. office and are made aware of the importance of filling out the inspection forms legibly and completely.

4.8 ACCURACY OF INSPECTION REPORTS

Electronic inspection reports had more non-match errors compared to manual reports. However, during the later months the difference between the two had decreased markedly. This may be due to inspectors being made aware of the reasons for the non-match for electronic inspections and are thus more careful while entering inspection data. This was consistent with the analysis given by the office of the State Director for the Maryland Division of FHWA/OMCHS. According to that analysis, the percentage of Maryland's current non-match rate has dropped substantially during the 18-month period of our analysis.

4.9 EFFICIENCY OF UPLOADING INSPECTION DATA

Data upload efficiency was measured as the time taken by the MSP-C.V.E.D. personnel to enter and upload inspection data to SAFETYNET. Electronically entered inspection reports were uploaded significantly faster when compared with manual inspection reports. The time taken for uploading electronic inspection reports was 18 minutes/batch compared to 347.5 minutes/batch for manual reports. This was mainly because manual reports have to be keyed-in, while electronic reports are downloaded.

In conclusion, electronic inspection systems have numerous advantageous compared to manual inspections. Although this is one of several safety-related components of CVISN, it was important to evaluate the post-implementation results of the inspection systems since doing so will enable policy makers and commercial vehicle administrators to objectively assess the outcomes of the CVISN implementations. This evaluation helps in determining the strengths and weaknesses of the systems being implemented.

Another important safety-related component of CVISN is the electronic screening system. It will be worthwhile to examine and evaluate the electronic screening system once it is operational. The study "Benefit-Cost Assessment of CVISN in Maryland" shows that the major benefits of CVISN will accrue due to investments in this safety-related component.

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APPENDIX A

SAFER Data Mailbox Focus Group Questions

1. How are the vehicles chosen for Inspection?

    - By using ISS
    - Random
    - Visual observations for obvious defects

2. What are the operational advantages?

    - Readability of inspection report
    - Verification of inspection for completeness
    - Amount of time spent on preparation of inspection report

3. What are the disadvantages of SAFER mailbox?

    - Lack of typing skills
    - Inability to use laptops outside because of glare, weather conditions, and the possibility of dropping the unit

4. Are we better off with this system?

    - Yes
    - Initial apprehensive attitude towards the use of computers

5. Number of trucks going through the facility per day

    - 1500-2000 per day at each facility (within 20 hour operation at some facilities)

6. Who selects the vehicles for inspection?

    - Sworn and civilian inspectors
    - Cadets / MdTAP officers

7. How many inspections per day?

    - 10-15 inspections per inspector (Levels I-III)

8. When is ISS used?

    - Usually at the beginning of the inspection

9. Does the ISS score determine which vehicle is inspected?

- No
- Weather and safety are major determiners of the level of inspection

10. Would ISS be used to select trucks to be inspected?

- Some inspectors do use ISS to select vehicles to be inspected
- It is helpful when spotting the wrong US DOT number on a vehicle

11. How accurate is ISS?

- Lack of inspection data on a carrier (limited number of inspections) may raise the score
- Prior violations are not "sure things" on particular driver and/or vehicle
- Experience has shown that scores are generally accurate, but inspectors don't always trust the data; it is rather used for comparison and for details concerning previous problems

12. Does ISS identify offenders?

- Yes
- Any carrier can be an offender.
- Most trucking companies are getting better and safer vehicles

13. Effectiveness in identifying repeat offenders

- Lack of experience with the system
- OOS is very important, but too much emphasis may be placed on the quantity of inspections and not on the quality

14. How will inspectors' job change?

- Improvements in technology and use of computers will increase the efficiency of the inspection process
- The operational advantage of an easy-to-use system, and the availability of more information for inspectors
- The relationship between enforcement and trucking communities can influence performance

15. Drawbacks

- System failures

- Outages
- Cost

16. Use of real time history

- Ability to track OOS violations and repeat offenders

17. Recommendations

- Elimination of drop down screen on ASPEN, which slows down the process
- A more efficient system is required for checking driver logbooks
- Inspection information and post-crash report should be together
- Use of CDLIS

Evaluation

- After the initial apprehension, the attitude of inspectors toward the use of computers is appreciative

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ACRONYMS

ASPEN	Hand-held pen-based inspection System
AVALANCHE	System, which Interfaces, with ASPEN and directs information to SAFETYNET
CJIS	Criminal Justice Information System
CVIEW	Commercial Vehicle Information Exchange Window
CVISN	Commercial Vehicle Information System and Network
CVO	Commercial Vehicle Operation
EDI	Electronic Data Interchange
FHWA	Federal Highway Administration
ICC	Interstate Commerce Commission
IFTA	International Fuel Tax Agreement
IRP	International Registration Plan
ISS	Inspection Selection System
ITS/CVO	Intelligent Transportation System/Commercial Vehicle Operations
MCMIS	Motor Carrier Management Information System
MDOT	Maryland Department of Transportation
MSP-C.V.E.D	Maryland State Police-Commercial Vehicle Enforcement Division
MVA	Motor Vehicle Administration
OMC	Office of Motor Carrier
OOS	Out-of-Service
OW/OS	Over Weight/Over Size
PIQ	Past Inspection Query
SAFER	Safety and Fitness Electronic Record System
ST	Semi Trailer
TR	Straight Truck
US DOT	United States Department of Transportation
WIM	Weight-in-Motion