

APPENDIX H

**Heavy-Duty Vehicle Warranty Survey**

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# Survey and Analysis of Heavy-Duty Vehicle Warranties in California | 15MSC009



Prepared for:

**California Air Resources Board &  
California Environmental Protection Agency**

December 2017

Prepared by:



Institute for Social Research | California State University, Sacramento  
6000 J Street | Sacramento, CA 95819-6101 | (916) 278-5737

Barbi Kerschner, M.A.  
David Barker, Ph.D

## Disclaimer

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# Acknowledgements

ISR would like to thank the heavy-duty vehicle owner/operators and heavy-duty repair shop/warranty providers who contributed to the success of this study by providing a greater understanding of their industry and the economic impact of warranty provisions in the State of California.

Special thanks to Jeff Lowry and Ron Haste of the California Air Resources Board for their assistance and input on this important project.

This Report was submitted in fulfillment of “15MSC009 – 1 STD 213A “Survey and Analysis of Heavy-Duty Vehicle Warranties in California” by the “University Enterprises, Inc.” under the partial sponsorship of the California Air Resources Board. Work was completed as of November 30, 2017.

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## Abstract

As a means of identifying and thoroughly analyzing the associated costs of lengthening current warranty periods for on-road heavy-duty vehicles, the ISR conducted surveys among heavy-duty vehicle owner/operators and heavy-duty repair shops in California, targeting those of a GVWR Class rating of 4 through 8. The vehicle owner/operators surveyed, reported more than 3,760 days of downtime, which resulted in a loss of revenue, exceeding \$1,360,750 collectively, due to the downtime required to complete necessary repairs on their vehicles. More than half of these vehicle owner/operators experienced some downtime over the past 10 years, and the majority of the costs of repairs were reportedly not covered under warranty. Repair shop owners/managers' survey responses did not entirely coincide with the experiences of vehicle owner/operators, in that repair shops tended to report shorter durations of downtime needed for repairs, and greater warranty coverage. Alternatively, the survey had good agreement with several queries with regard to the number of vehicles that had warranties and certain costs, such as the average claim cost per vehicle. With the limited information we were able to obtain from industry professionals, we observed significant correlation within the survey.



# Executive Summary

## Background:

The California Air Resources Board (CARB) contracted the Institute for Social Research (ISR) at California State University, Sacramento, to develop surveys to assist CARB in gaining insight into the cost structure and related manufacturer and consumer expenses for on-road heavy-duty vehicle warranties currently offered in California. Of particular interest was information on repairs outside of warranties, not including regular vehicle maintenance such as oil and filter changes. The confidential and competitive nature of extended warranty transactions in which warranties are frequently used as marketing enticements, makes it difficult to determine actual costs.

## Methods:

Online surveys were administered to identify how heavy-duty vehicle warranties vary by customer, manufacturer and fleet pattern; the number of warranties purchased annually; and the quantifiable financial consequences associated with maintenance outside of warranties. The first survey was administered by ISR to 40,801 on-road heavy-duty vehicle operators and owners (GVWR Class 4 through 8) randomly selected from a sample of 400,000 possible respondents.

Out of 860 owner/operator completed surveys, ISR used 539 responses for analyses. The data was cleaned to remove invalid and incomplete surveys (e.g., data were discarded because of suspiciously quick times to completion and/or incomplete surveys). The 539 completed owner/operator responses obtained, correlate to a margin of error of +/- 4.5 to 5 percent, which renders the data reliable. After data collection had ceased for the owner/operator survey, ISR randomly selected five individuals to whom \$100 gift cards were sent via their provided email address.

In addition, ISR telephoned a sample of 370 on-road heavy-duty vehicle repair shop owners and or managers to interview them regarding the types of warranties, repairs and services provided, and on what type of vehicles, the repair shop conducts repairs. Ninety-two responses were collected from repair shop owners/managers, and were used for analyses.

## Key Findings

### Results Owner/Operator Survey

- The majority of heavy-duty vehicle owner/operators whose engine has required a rebuild or replacement (52%) believe a 500,000 mile warranty should be standard although they were given the option to select -'other' longer warranty duration.
- Of those that have an extended warranty, more than half, (55%) say their extended warranty package cost them over \$2,500.
- Forty percent of new engines sold had warranties that extended to 417,000 miles on average.
- Owner/operators indicated that the average cost of repairs over a range of 508,000 miles was \$4,177 per vehicle (for vehicles needing repairs).
- More than half of the owner/operators (54%) reported having experienced extended downtime due to repairs; 62% said those repairs were not covered under warranty.

- Additionally, there were a significant number of days of lost revenue due to downtime for repairs. Following is a breakdown (see Table 1) of the average number of days of downtime due to vehicles being out of commission (1.5% responded 'unsure'):

Table 1 – Owner/Operator | Length of Repair Downtime

Length of Downtime	% Owners	Estimated Total Days
1-2 days	14%	57
3-6 days	32%	396
1-2 weeks	19%	742
3-4 weeks	16%	1,078
More than 1 month	17%	> 1,400
Total	98%	> 3,673

- Owner/operators indicated that there was a significant loss of revenue attached to the downtime. See Table 2 for the estimated costs associated with downtime as reported by on-road heavy-duty vehicle owners/operators:

Table 2 – Owner/Operator | Loss of Revenue due to Downtime

Loss of Revenue	% Owners	Estimated Total Revenue
Zero	5%	-
\$1- \$999	10%	\$13,500
\$1,000 - \$4,999	32%	\$261,000
\$5,000 - \$7,499	18%	\$312,500
\$7,500- \$9,999	11%	\$253,750
> \$10,000	19%	\$520,000
Unsure	5%	-
Total	100%	\$1,360,750

## Results Repair Shop Interviews

- Repair Shop owners/managers indicated that the most frequent year(s) of heavy-duty vehicles that come in for repairs are either models earlier than 2007 (25%), or 2010 and 2011 models (24%).
- The majority of repair shops (56%) provide extended warranties (a warranty package that covers beyond the life of the manufacturer's mandatory warranty period) to their heavy-duty vehicle customers.
- The average cost of the most frequently purchased extended warranty package falls between \$1,000 and \$2,500 (41%), according to repair shop owners/managers.
- The majority (59%) of extended warranty packages cover one to two years beyond the life of the mandatory warranty period according to the repair shop owner/managers.

- According to repair shop owners/managers, 70% of extended warranty packages cover the cost of both parts and labor.
- When asked how long it takes to conduct repairs, a little more than half of repair shop owners/managers (51%) indicated one to two days, and another 21% indicated 3-6 days.
- When asked to rank the frequency of repairs provided, repair shop owners/managers named the following as the most frequent (percentage indicates the percent of managers who indicated that repair in the top five); diesel particulate filters (54%), SCR related repairs (37%), and fluid leaks (30%) were among the most frequently reported.

### Conclusions:

With input from heavy-duty vehicle owner/operators and repair shops, the current research has provided greater knowledge of the financial burden of downtime and repair costs to the owners of these vehicles. These owners report that their vehicles are no longer covered by the manufacturer's mandatory warranty or by an extended warranty for their used/in-service vehicles (see Figure 12 below). This contrasts with the survey findings (and industry assertions) that 40-50% of all new heavy-duty vehicles are sold new with 400,000 - 500,000 mile extended warranties, and that a significant portion of the remaining new vehicles are sold with 250,000 mile warranties according to published and industry provided data. Accordingly, these data suggest that heavy-duty vehicle owners/operators and other industry professionals may benefit from longer warranty periods, protecting them from unexpected and seemingly 'unfair' repair costs as emissions requirements become more stringent in the coming years.

# I. Introduction

Due to the many challenges faced by California in reaching the State's ambient air quality goals, the California Air Resources Board (CARB) contracted with the Institute for Social Research to gather information to address these goals. Of primary concern is the need for a substantial reduction in both oxides of nitrogen (NOx) and PM2.5 emissions by on-road heavy-duty vehicles, as they are significant contributors of these emissions (CARB, 2016). CARB suggests that the current definitions surrounding the useful life of heavy-duty engines and the associated emission warranty periods require an update to reflect the increased operational lives of modern engines. Gaining an understanding of the current average costs and duration of extended warranties will inform future regulations.

## II. Study Method

The objectives of this study include understanding:

- The ways in which on-road heavy-duty vehicle warranties vary by customer, manufacturer and fleet pattern;
- The number of warranties purchased by professionals annually; and
- The quantifiable financial consequences associated with maintenance outside of warranties.

The ISR obtained approval from the Institutional Review Board of California State University, Sacramento to complete a representative survey of heavy-duty, on road vehicle drivers in California and heavy-duty vehicle repair shop managers in California. The ISR employed a mixed-method approach to data collection. On November 17, 2016, ISR researchers piloted the owner/operator survey via email, sending potential respondents an invitation to take the survey (see Appendix A), which included a link to the survey (see Appendix B) embedded in the Qualtrics<sup>1</sup> online data collection platform. The pilot test returned 17 completed surveys out of 282 invitations equating to a 6% response rate. After the pilot period, ISR resumed data collection on February 7, sending the invitation to the remaining email addresses within our sample, and employed a second mode of data collection that involved sending texts (see below for details on the texting protocol).

Protocol for data collection via texts:

- Send numbers from the randomly selected sample flagged as 'cellular' by MSG to Carrier lookup<sup>2</sup>;
- Send an informational text introducing the study via the mail-merge function in Microsoft Word that includes an 'opt out' option as required by Telephone Consumer Protection Act (TCPA) rules and a link to the ISR website;

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<sup>1</sup>Qualtrics is a secure survey software company that enables users to do many kinds of online data collection and analysis including market research, customer satisfaction and loyalty, product and concept testing, employee evaluations and website feedback.

<sup>2</sup>Carrier Lookup provides the cellular carrier email information allowing researchers to send text via an email account set up in advance, making it easier to collect and follow up on responses to opt out, or to provide more information.

- 48 hours after sending the informational text (to allow people time to opt out) send a second text to those who had not opted out that includes a link to the survey and a link to the ISR website (with another opportunity to opt out);
- One week later, send reminder texts to all phone numbers that had not already completed a survey, and had not opted out, offering a five dollar (\$5) gift card to those who complete the survey. In all, we distributed \$5 gift cards to 167 survey respondents.

A statistically representative sample of these two groups (with a +/- 5% margin of error) was accomplished with a total of 539 heavy-duty vehicle owner/operators and 92 repair shops/warranty providers. ISR specifically targeted those vehicle operators and repair shops affiliated with GVWR classes 4 through 8.

Prior to contacting potential participants, ISR researchers constructed a web page for the project with contact information and a description of the project. We included a link to the informational web page in all correspondence to potential respondents. The web page proved to be very useful in addressing concerns of the purpose and legitimacy of the project for potential participants.

## Participants | Heavy-Duty Vehicle Owner/Operators

CARB provided the sample of potential participants for the heavy-duty vehicle owner/operator study in the form of two databases.

- The 2016 Truck and Bus Online Reporting (TRUCR) database<sup>3</sup>.

The TRUCR database included a total 25,254 records, which included names, postal, and email addresses. After scrubbing the file for anyone living outside of California, 25,071 records remained from which a random sample of 12,200 became the sample used for the pilot test and email methodology.

- The California Highway Patrol public registry database (MISTR).

The MISTR database provided by CARB, for the ISR to contact via text, was a public registry database of Motor Carrier Profiles to which all vehicle owner/operators provide information to the California Highway Patrol. The carrier MISTER data included 385,785 records with names and phone numbers from which Marketing Services Group (MSG)<sup>4</sup> returned with 351,179 appended cell phone numbers to whom the ISR was to contact in an attempt to collect data via the texting protocol approved by the CARB staff. Additionally, MSG provided the ISR with a sample of known heavy-duty vehicle operators as determined by industry codes ( $n = 34,605$ ). See Appendix D for the list of Service Industry Codes (SIC) used to determine this sample.

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<sup>3</sup> The TRUCR database consists of fleet owners required to report on their use of flexibility options and who do not meet the current requirements set forth by the California Air Resources Board's Truck and Bus Regulation and may not be representative of all heavy-duty vehicle owner/operators.

<sup>4</sup> Marketing Systems Group (MSG) provides products and services designed specifically for survey research environments. They specialize in Sampling and provide the support needed to meet the growing needs of the research conducted at the ISR.

In an attempt to gauge respondent rates and to ensure quality data collection, ISR first piloted the study in Spanish and English to a randomly selected portion of participants in November 2016, having sent emails with a link to the survey in Qualtrics to 284 records. The final survey was administered in February 2017. Owner/operators were given \$5 gift cards when they completed the survey, and five respondents were randomly selected and received \$100.00 gift cards.

## Participants | Repair Shop Managers

ISR and CARB staff collaborated to construct a similar survey (see Appendix C) to be administered to heavy-duty vehicle repair shops managers/warranty providers. ISR programmed the survey tool into Qualtrics and interviewed repair shop employees ( $n = 92$ ) by phone.

In order to reach our intended population of CA heavy-duty vehicle repair shop managers/warranty providers, we initially gathered a sample of 200 records by searching the internet using such search terms as; “heavy-duty engine repair,” “commercial diesel repair,” “diesel repair shop” and variations thereof. When those contacts had been exhausted, a second wave of sample was purchased from MSG and was comprised of telephone numbers of 170 businesses with Standard Industrial Classification (SIC) codes consistent with the industry for Diesel Engine Repair: Automotive, and Industrial Truck Repair). In an attempt to obtain additional respondents, we conducted a second internet search for our targeted population specifically searching the names of large cities or cities along major California highways (e.g., I-5, I – 80, Highways 1 and 101, and the 405 Freeway) to the search terms. Additionally, we put in special effort to locate repair shops on the premises of, or affiliated with dealers/manufacturers of on-road heavy-duty vehicles.

Data collection for heavy-duty vehicle repair shop managers took place over a 3-week period (June 2017 through August 2017) and was administered by ISR. As per data confidentiality protocol, interviewers did not collect any identifying information from participants. To screen out under-aged or potentially non-qualifying participants, researchers began the interview by ensuring that the shop provides repairs for heavy-duty Class 4 through 8 engines and that the respondent was at least 18 years of age.

Researchers kept track of the outcome for each call and each participant record in an excel file organized for these purposes. Telephone protocol required interviewers to attempt to schedule callbacks with respondents who were too busy to be interviewed at the time of the call. Researchers continued attempts at reaching repair shops at least two subsequent times, among those shops that had not completed a survey, or had not opted out in previous contact.

### III. Results

#### Survey Results | Owner/Operators

ISR conducted analyses utilizing IBM\_SPSS statistical software to determine frequencies, distributions and correlations between the variables of interest. The following is a breakdown of the analyses for each of the survey questions posed to heavy-duty vehicle owner/operators.

The number of on-road heavy-duty vehicle owner/operators (539) in the study was divided between those who own and operate one truck (49%) and those who own and operate two or more trucks (51%). While the targeted sample was to include Gross Vehicle Weight Rating (GVWR) classes 4 through 8, the majority were owner/operators of Class 8 vehicles with a GVWR greater than 33,000 lbs. (see *Figures 1 and 2*).

Figure 1 – Owner/Operator | Number of Trucks Owned

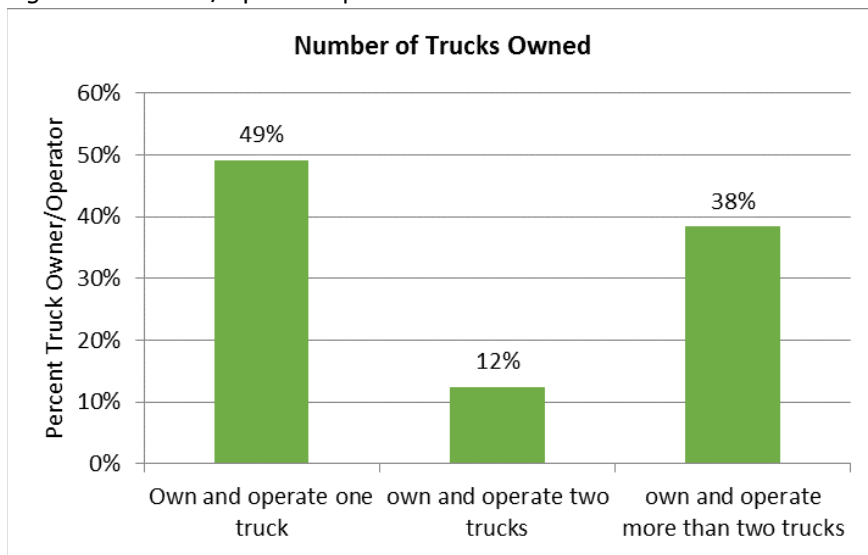
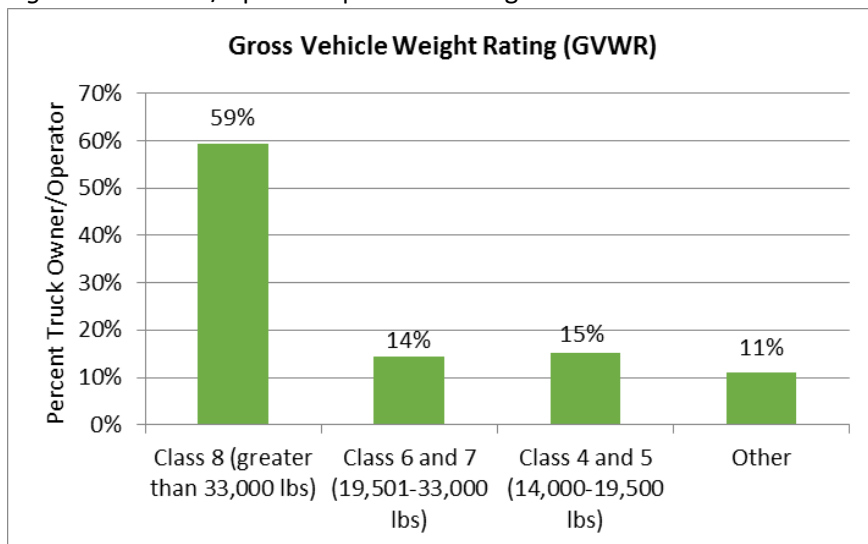
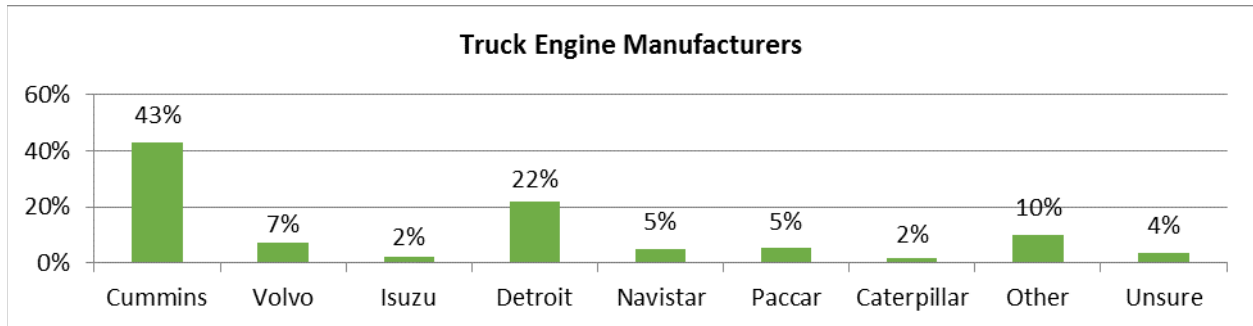


Figure 2 – Owner/Operator | GVWR Rating



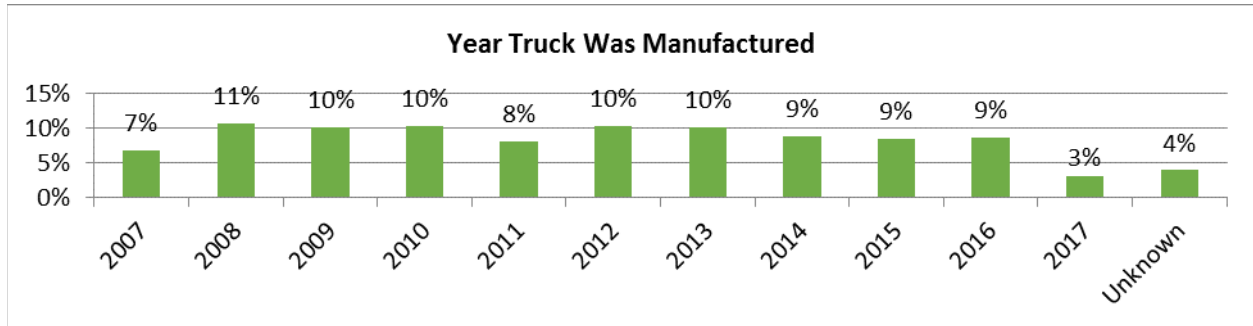
Owner/operators participating in the survey owned a wide range of engine types. The most common engine types were Cummins (43%) and Detroit (22%) see *Figure 3*.

*Figure 3 – Owner/Operator | Truck Engine Manufacturers*

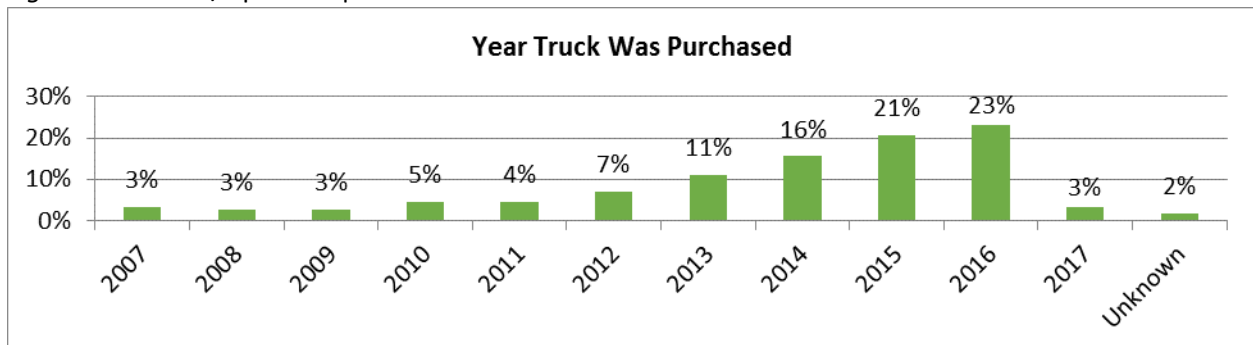


Owner/operators represented a wide range of truck age as well as years in which their truck was purchased (see *Figures 4 and 5*).

*Figure 4 – Owner/Operator | Year Truck Was Manufactured*



*Figure 5 – Owner/Operator | Year Truck Was Purchased*

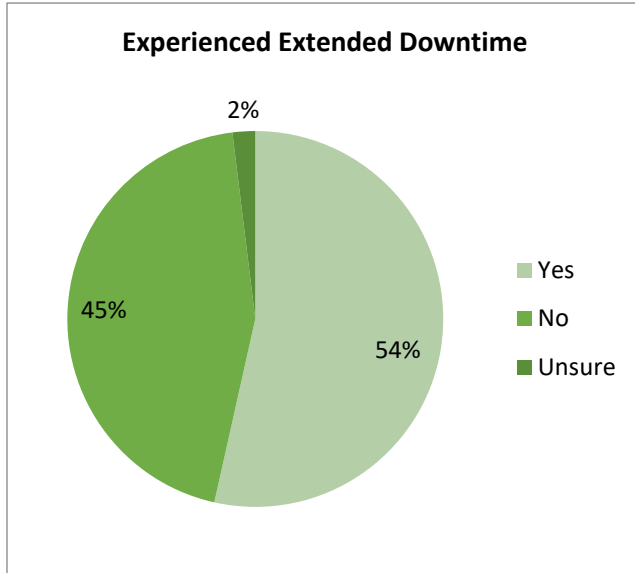




### Cost of Repairs

Fifty-four percent of the owner/operators indicated that that their vehicle required repairs resulting in downtime (see *Figure 6*). See Table 3 for a breakdown of the average costs of repairs among those requiring repairs ( $n = 275$ ):

*Figure 6 – Owner/Operator | Extended Downtime*



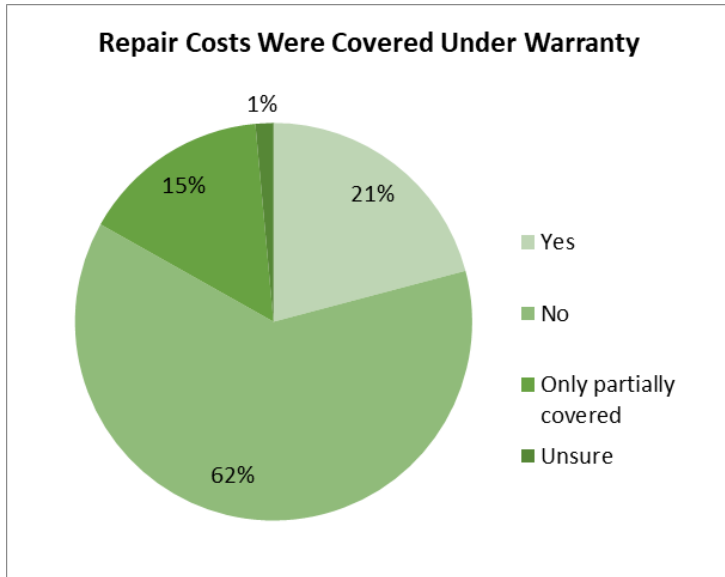
*Table 3 – Owner/Operator | Cost of Repairs*

Cost of Repairs	Owners/Operators		Estimated Total Cost
	#	%	
< \$1,500	20	7%	\$15,000
\$1,500 – \$3,999	73	27%	\$200,750
\$4,000 – \$7,999	67	25%	\$402,000
\$8,000 – \$10,999	37	14%	\$351,500
\$11,000 – \$14,999	18	7%	\$234,000
\$15,000 – \$20,000	27	11%	\$507,500
Other/Unsure	25	9%	-
<b>Total</b>	<b>242</b>	<b>91%</b>	<b>\$1,710,750*</b>

\*21 percent of these costs (\$359,258) were fully covered and 15 percent (\$202,724) were partially covered by warranties, leaving \$1,148,768.00 of repair costs on the vehicle operators/owners.

Sixty-two percent of owner/operators' vehicle repairs were not covered by warranty (see *Figure 7*).

*Figure 7 – Owner/Operator | Repair Costs Covered by Warranty*



Of those who owned an extended warranty package, 78 percent reported coverage for an extended two – five years; the majority of those packages (70%) were provided by the dealer (see *Figures 8 and 9*).

*Figure 8 – Owner/Operator | Additional Years on Extended Warranty*

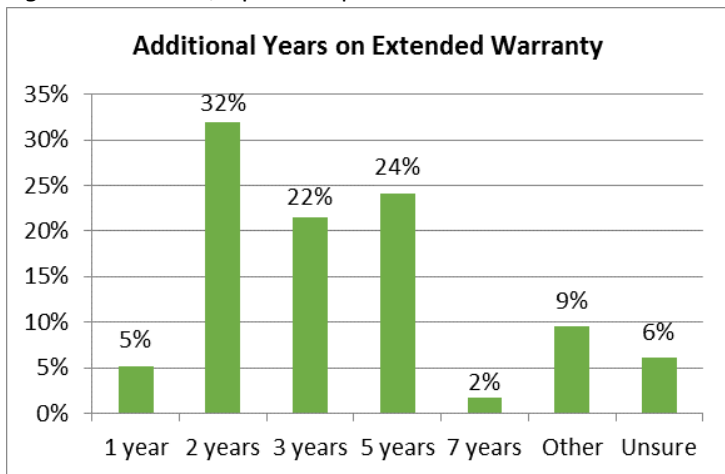
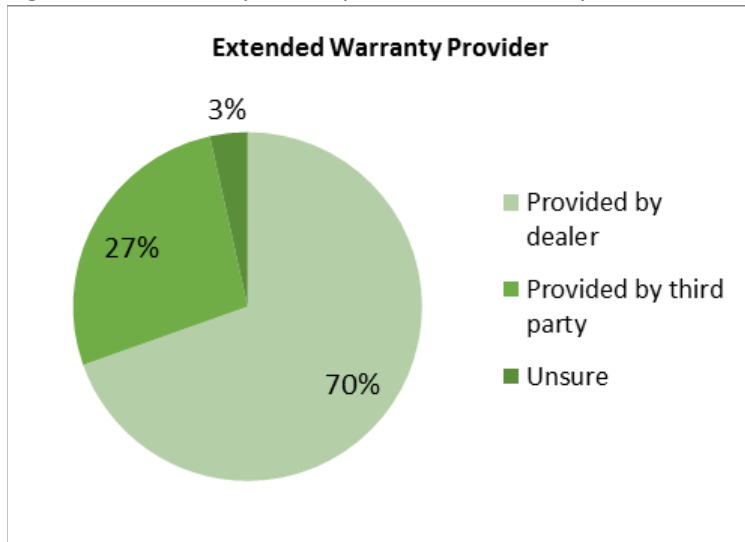


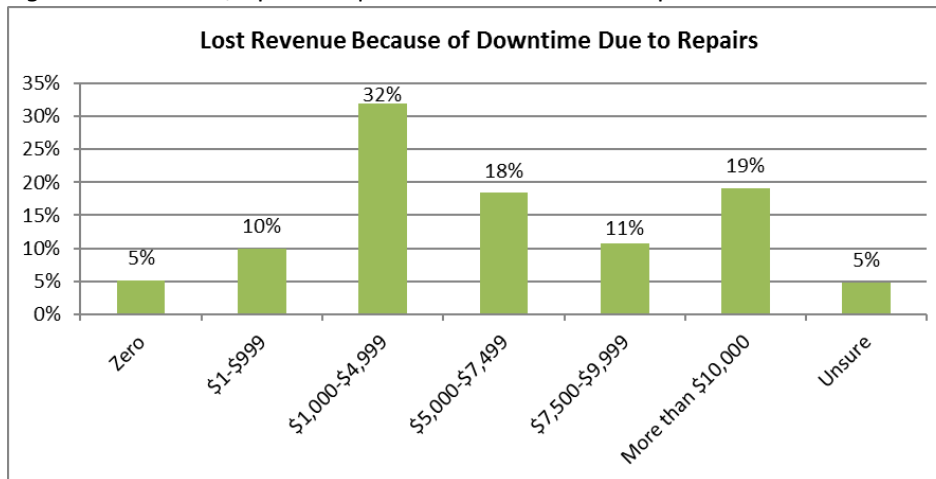
Figure 9 – Owner/Operator | Extended Warranty Provider



### Lost Revenue due to Repair Downtime

The total number of days of lost revenue (over the life of their vehicle, on average) among the current sample was 3,673 days (equivalent to ten years). Owner/operators also indicated that there was a significant loss of revenue attached to the repair downtime (Figure 10).

Figure 10 – Owner/Operator | Lost Revenue Due to Repairs

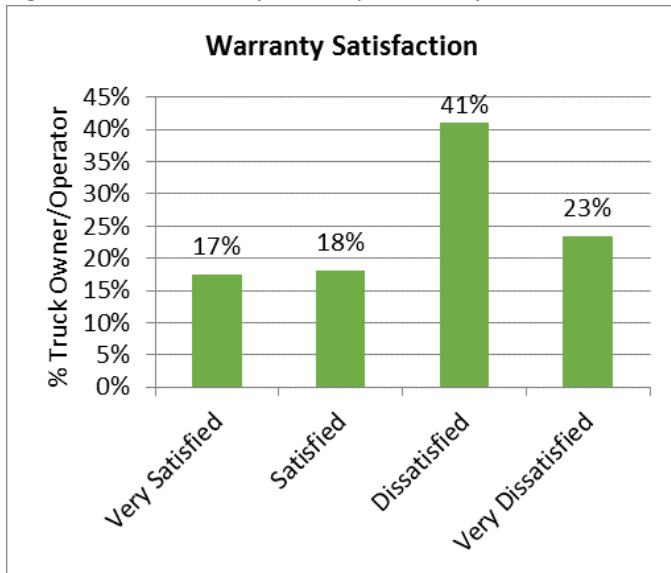


Combining the estimated cost of repairs not covered under warranty (\$1,148,768.00) with the estimated loss of revenue due to downtime for repairs (\$1,360,750.00) provides a total estimate of the statewide economic impact of \$2,509,518 over a ten-year period. Repairs and downtime are estimated as having occurred within the ten-year period in which vehicles were manufactured (2007 to 2017).

### Customer Satisfaction

The majority of vehicle owner/operators (64%) report being dissatisfied or very dissatisfied with the current mandatory parts and labor warranty of five years per 100,000 miles provided by their vehicle manufacturer (see Figure 11).

Figure 11 – Owner/Operator | Warranty Satisfaction



### Warranty Types

Only a small percentage (24%) of owner/operators report having an extended warranty that provides protection beyond the mandatory coverage; however, for those that have an extended warranty, 84 percent report that it covers both parts and labor, with a wide variance of the number of additional miles covered (see *Figures 12, 13, and 14*). The majority of these extended warranties (60%) cost anywhere from \$1,000 to \$5,000 (see *Figure 15*).

Figure 12 – Owner/Operator | Extended Warranty

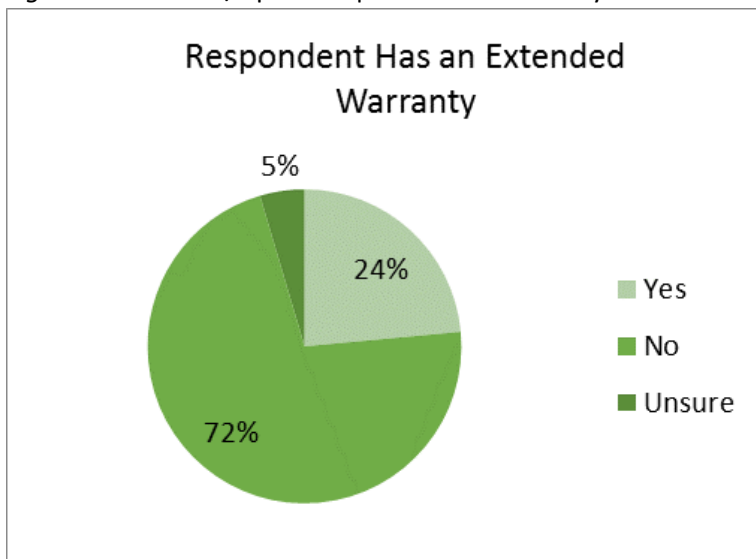


Figure 13 – Owner/Operator | Extended Warranty Coverage

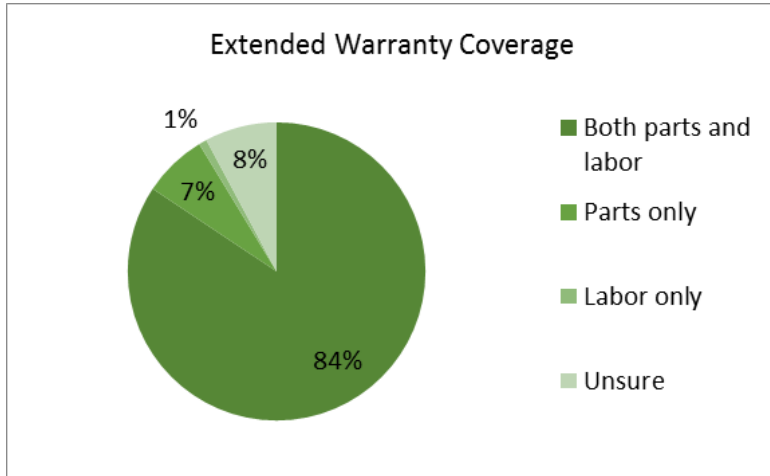


Figure 14 – Owner/Operator | Range in Miles of Extended Warranty

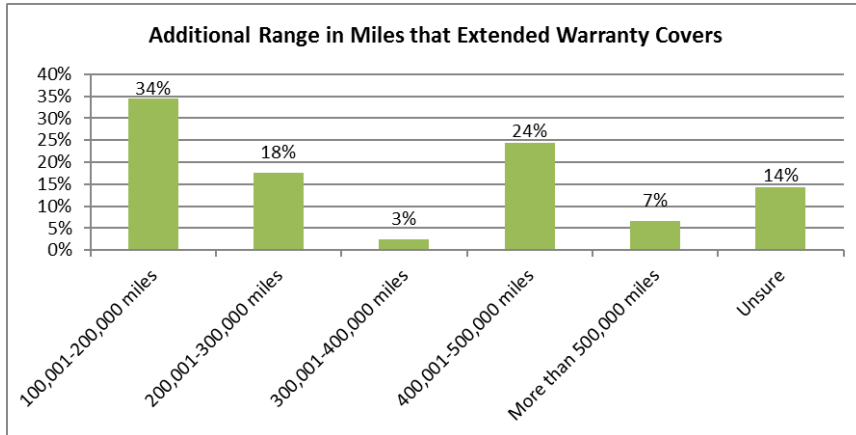
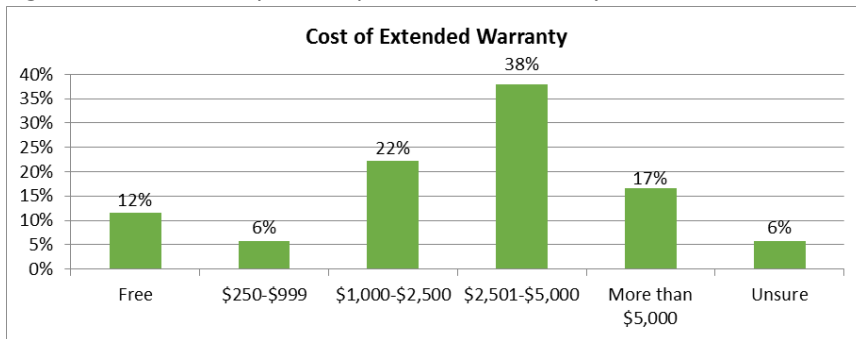


Figure 15 – Owner/Operator | Extended Warranty Cost



Of the 17 percent who indicated that their extended warranty cost more than \$5,500, only 12 individuals wrote in the amount they spent. Among those 12 individuals, the average cost for an extended warranty was \$7,233; the highest amount paid was \$10,500.

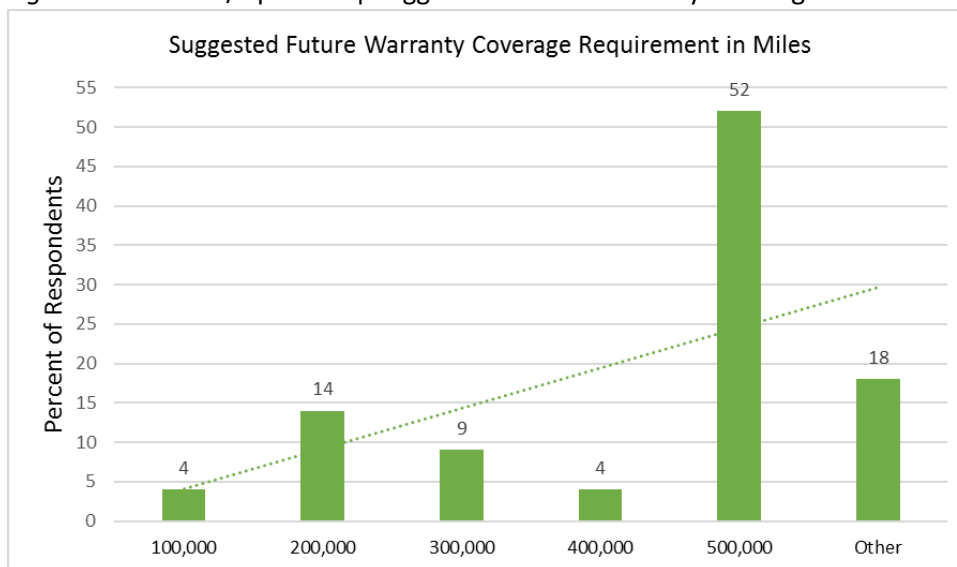
For those who reported that they had purchased an extended warranty, see Table 4 for a breakdown of GVWR class and number of miles/years on the extended warranty.

Table 4 – Owner/Operator | Type Warranty Purchased by GVWR Type

Vehicle Mileage	Class 8	Class 6 and 7	Class 4 and 5
100,001-200,000 miles	25%	50%	50%
200,001-300,000 miles	36%	8%	13%
300,001-400,000 miles	4%	-	-
400,001-500,000 miles	28%	25%	13%
> 500,000 miles	8%	-	6%
Extended Warranty	Class 8	Class 6 and 7	Class 4 and 5
1 year	5%	33%	-
2 years	31%	33%	13%
3 years	19%	25%	25%
5 years	31%	8%	6%
7 years	-	-	13%

Some industry professionals have claimed that heavy-duty vehicle owner/operators may only be expressing dissatisfaction with the current warranty length because they want to get something without having to pay. However, when asked about warranty coverage going forward, 52 percent of owner/operators elected for a mandatory manufacturer warranty covering 500,000 miles, although they could have opted for the ‘other’ category and written in a greater amount of coverage (see *Figure 16*).

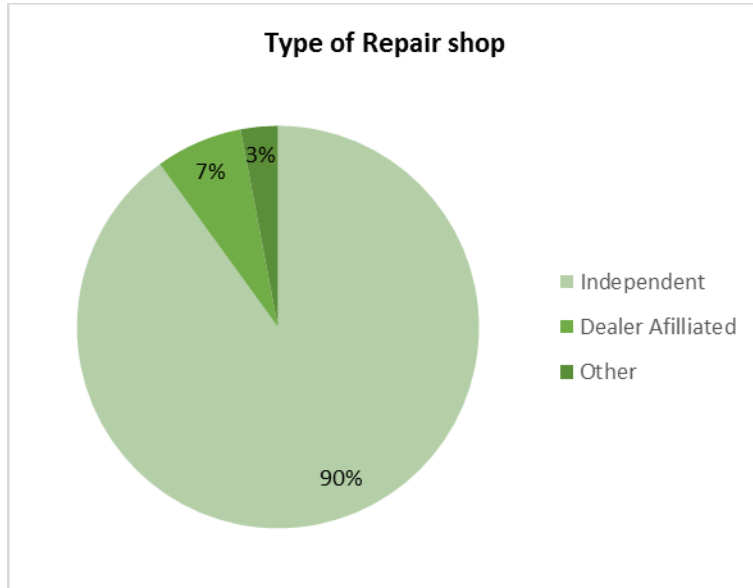
Figure 16 – Owner/Operator | Suggested Future Warranty Coverage



## Interview Results | Repair Shop Manager

Most of the repair shop managers ISR interviewed indicated their repair shops were independent (90%), not affiliated with a specific dealership (see *Figure 17*).

*Figure 17* – Type of Repair Shop



## Warranties

Additionally, most repair shop managers indicated that the repair shop provided extended warranties beyond that which the manufacturer provides (56%) and work on vehicles with extended warranties (56%). The majority of repair shop managers reported extended warranties costing between \$1,000 and \$5,000 (68%) and 18 percent report the cost as \$5,000 or more (see *Figure 18*) with most extended warranties covering from less than 100,000 miles to 300,000 miles (80%) see *Figure 19*.

*Figure 18* – Repair Shop | Cost of Extended Warranties

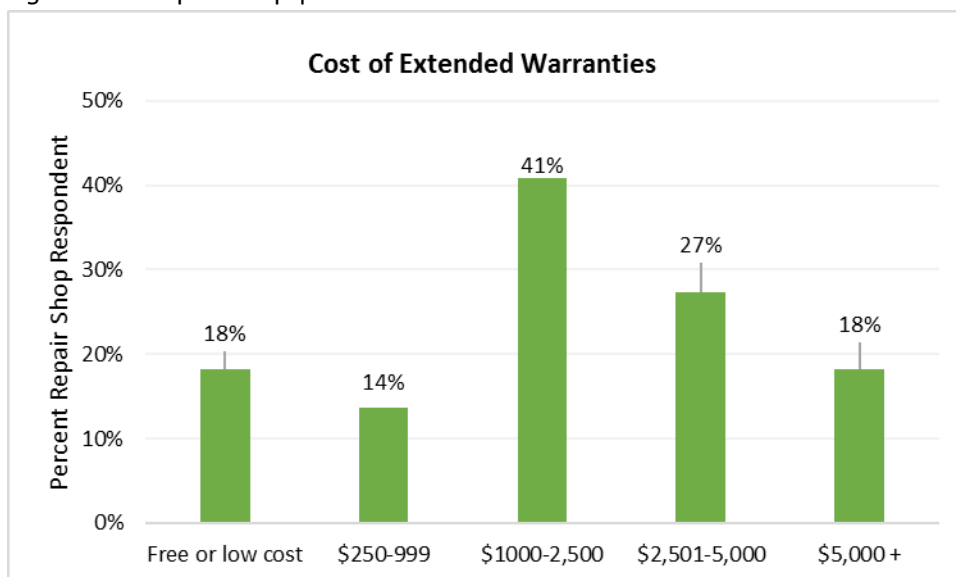
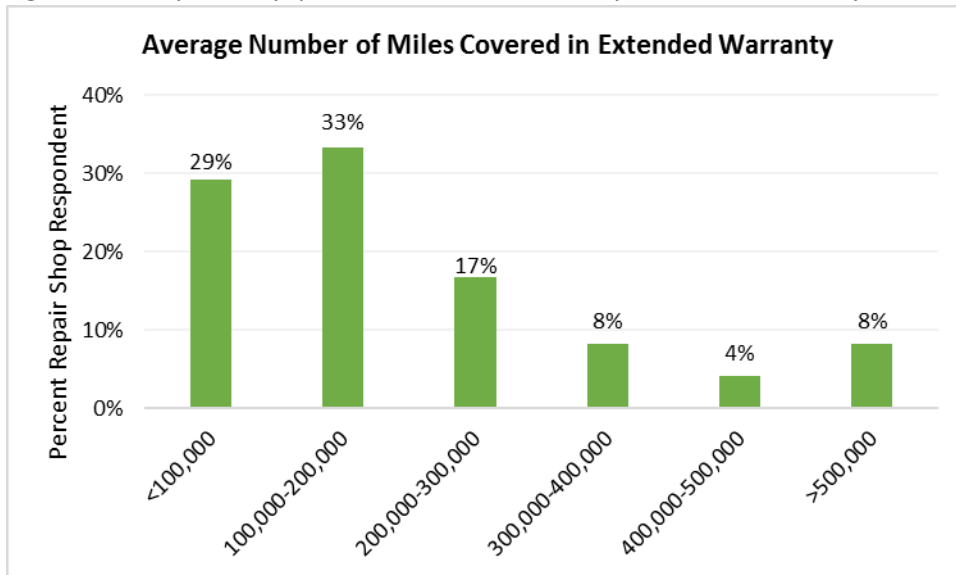


Figure 19 – Repair Shop | Number Miles Covered by Extended Warranty



### Customer Satisfaction

When we asked the repair shop managers how satisfied they believed their customers to be with the current mandatory parts and labor warranty of five years/100,000 miles provided by their vehicle manufacturer, many (20%) were hesitant to provide a response. However, those that did respond reported that they believe close to half of the heavy-duty vehicle owners are satisfied with their warranties (see Figure 20).

Figure 20 – Repair Shop | Customer Satisfaction with Warranty





## Common Types of Trucks under Warranty

Repair shop managers reported Cummins, Caterpillar, and Detroit Diesel as the most commonly manufactured heavy-duty vehicle engines, and Class 8, as the GVWR on which they most frequently work (see Figures 21 and 22).

Figure 21 – Repair Shop | Most Common Truck in Repair

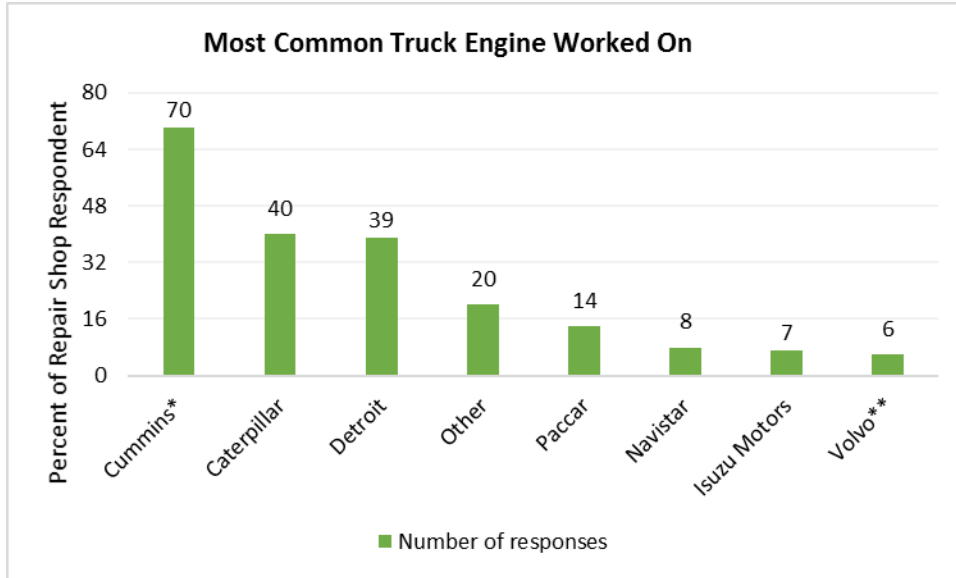
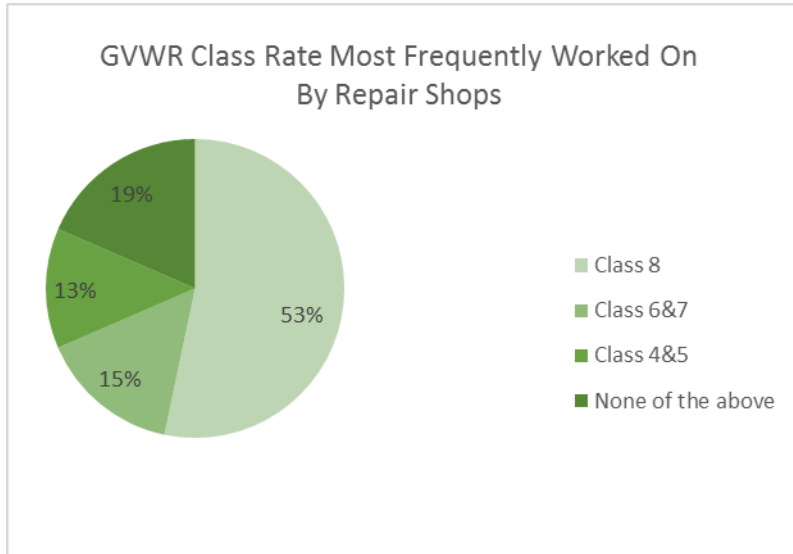


Figure 22 – Repair Shop | Most Frequently Worked on GVWR class\*

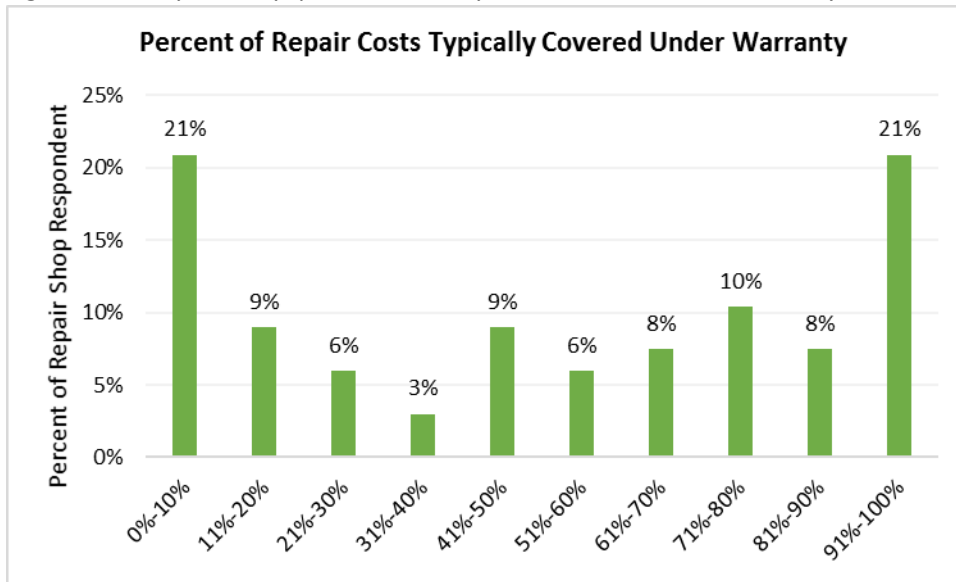


\*The 19 percent who opted to reply 'none of the above' is reflective of the frustration of repair shop managers in attempting to answer questions that they expressed as being too difficult considering the variation of services they provide, and the diversity of vehicles on which they work.

## Warranty Coverage of Repair Costs

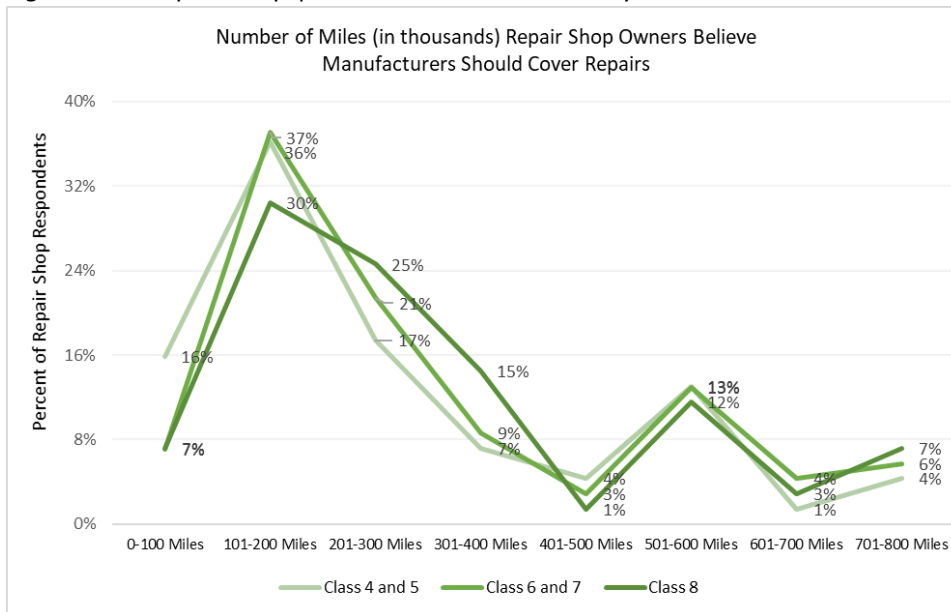
Repair shop managers varied with their responses as to what percent of repair costs were typically covered under warranty (see Figure 23).

Figure 23 – Repair Shop | Percent of Repairs Covered Under Warranty



Yet they were consistent across class types with their suggestion of how many miles manufacturers should be required to cover the cost of repairs for Class 4 and 5, Class 6 and 7, and Class 8 engines. Figure 24 shows the breakdown for each class type.

Figure 24 – Repair Shop | Number of Miles Warranty Should Cover



## Lost Revenue due to Repair Downtime

In contrast to what was reported by heavy-duty vehicle owner/operators (a majority of whom reported 3-6 days of downtime or longer), 51 percent of repair shop managers reported 1-2 days of downtime due to repairs (see *Figure 25*). It should be noted that 21 percent of repair shops interviewed were either unwilling to say, or unsure of the average amount of time it takes for repairs.

*Figure 25* – Repair Shop | Average Time for Repairs



## IV. Discussion

There is an overall contention by State regulators, and other industry professionals, that the current manufacturer warranty requirements for on-road heavy-duty vehicles are not sufficient to guarantee that emission control performance will be maintained throughout the exceptionally long service life of modern heavy-duty vehicles, (e.g., up to 1,200,000 miles). This lack of emission control maintenance may contribute to a negative economic impact, and poorer air quality in California. This impression is supported in large part by the results of the owner/operator survey summarized herein. Longer warranties could potentially assist with reduced emissions, and provide better longevity and durability for such vehicles. Specifically, longer warranties may contribute to timelier repair of malfunctioning components in heavy-duty vehicles, and will likely lead to better vehicle maintenance (source CARB).

### Summary/Conclusions

Within the study, the owner/operator survey data agrees with data provided by the heavy-duty vehicle industry. For example, industry approximates that 50 percent of new Class 8 engines already come with 500,000-mile warranties from the factory, and our survey cross query data indicated that 40 percent of all new Class 4 through 8 vehicles come equipped with 417,000-mile warranties when purchased new from the dealer. As well, there was very good agreement (< 5% difference) between the reported \$4,177 average cost of repairs per vehicle (for vehicles needing repairs) by heavy-duty-vehicle owner/operators, and an independent source. The current study underscores the dilemma experienced by heavy-duty vehicle operators in attempting to keep their vehicles in good running order, without experiencing lengthy downtime and exorbitant repair costs.

In other cases, however, there were discrepancies between information reported by the vehicle owner/operators and the repair shop/warranty providers with respect to reported downtime. Repair shops reported an average of two days of downtime for repairs, while the vehicle operators indicated 9.5 days of downtime for repairs (on average). It should be noted however; that 21 percent of repair shop managers could or would not say how long it takes, citing a wide variance of repair problems on which they work. As well, the discrepancies in reporting could be due to the repair shops only reporting the time they actually work on the vehicle without factoring in time to order parts, or the amount of time vehicles sit on the lot waiting for a mechanic or tool to become available.

### Recommendations

Despite the barriers to obtaining accurate and unbiased information for heavy-duty vehicle owner/operators and repair shops, the current study addresses those barriers, and provides accurate information on which we can make assumptions to inform decisions going forward. There is an immense amount of complexity involved in the estimation of the costs associated with increasing the emission warranty periods of on-road heavy-duty vehicles, and as such, alternative methods for gathering such information should be visited. It would be beneficial to seek ways to institutionalize the type of data collection offered here, perhaps incentivizing members of the industry to participate in voluntary audits, or other systemized reporting by industry professionals. By investing in the gathering of primary, versus self-reported data, it could allow CARB to identify with greater accuracy, the specific mileage, downtime, repair costs, and warranty provisions within the trucking industry, which is an integral part of California's economy.

## Appendix A | Email Invitation

Dear Truck Owner/Operator,

University researchers need your help to better understand heavy-duty truck warranties.

Please click here: [WARRANTY SURVEY](#) to take a short survey (offered in English or Spanish) about your truck's engine and warranty/service agreements. For more information on this study, see [www.csus.edu/isr](http://www.csus.edu/isr) or call Barbi Kerschner, CSUS Research Analyst at 916.278.2695.

Five respondents will receive a \$100 gift card to spend almost anywhere.

Thank you in advance for participating in this important survey.

Barbi Kerschner

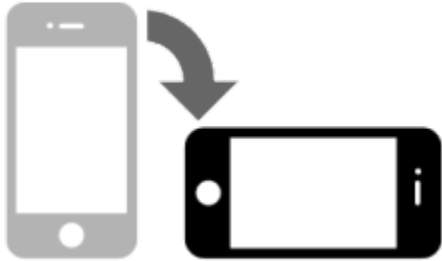
Research Analyst

Institute for Social Research, CSUS

# Appendix B | Truck Owner/Operator Survey

## CARB Truck Owner/Operator Survey (offered in English and Spanish)

For optimal viewing please rotate your phone



Intro Thank you for volunteering to participate in this important survey! Please answer the following questions about the truck you currently own/operate. As a thank you for taking the time to answer our survey, you will be entered to win one of five \$200 Tango gift cards. The survey should take 5 to 10 minutes to complete. Thank you again for your participation! For more information please visit our [WEBSITE](#)

Are you 18 years or older?

- Yes
- No

Display This Question:

If Are you 18 years or older? No Is Selected

Participants must be 18 years or older to participate in this survey. Thank you for your time!

If Participants must be 18 yea... Is Displayed, Then Skip To End of Survey

Please tell us about your truck ownership...

- I own and operate one truck
- I own and operate two trucks
- I own and operate more than two trucks

If I own and operate one truck Is Selected, Then Skip To Who manufacturers your truck's engine? If I own and operate two trucks Is Selected, Then Skip To As an owner of more than one truck, p...

Display This Question:

If Please tell us about your truck ownership... I own and operate two trucks Is Selected

As an owner of more than one truck, please answer the survey about only one of your trucks manufactured between 2007 and 2017 and answer all questions regarding that same truck.

- Please click here when you have a truck in mind about which you will answer the survey questions.

Display This Question:

If Please tell us about your truck ownership... I own and operate more than two trucks Is Selected

As an owner of multiple trucks, please answer the survey about only one of your trucks manufactured between 2007 and 2017. To help you decide which truck to use for the survey, please select a truck that is neither your newest nor your oldest truck, and answer all questions regarding that same truck. Please click here when you have a truck in mind about which you will answer the survey questions.

- Please click here when you have a truck in mind about which you will answer the survey questions.

Who manufactures your truck's engine?

- Cummins
- Volvo
- Isuzu Motors
- Detroit
- Navistar
- Other (please indicate) \_\_\_\_\_
- Unsure

What is the Gross Vehicle Weight Rating (GVWR) of your truck?

- Greater than 33,000 lbs (Class 8)
- 19,501 to 33,000 lbs (Class 6 and 7)
- 14,000 to 19,500 lbs (Class 4 and 5)
- Other (please indicate) \_\_\_\_\_

When was your truck manufactured?

- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- Unknown

What year did you purchase your truck?

- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- Unknown

What is the current odometer reading on your truck? Write in \_\_\_\_\_

How satisfied are you with the current mandatory parts and labor warranty of 5 years/100,000 miles provided by the manufacturer?

- Very satisfied
- Satisfied
- Dissatisfied
- Very dissatisfied

Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires?

- Yes, I have an extended warranty
- No, I do not have an extended warranty
- Unsure

Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires... Yes I have an extended warranty Is Selected

How much did your extended warranty package cost?

- It was free
- \$250 - \$999
- \$1,000 – \$2,500
- \$2,501 - \$5,000
- More than \$5,000 (please indicate) \_\_\_\_\_
- Unsure



Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires? Yes Is Selected

What additional range in miles does your extended warranty package cover?

- 100,001 – 200,000 miles
- 200,001 – 300,000 miles
- 300,001 – 400,000 miles
- 400,001 – 500,000 miles
- More than 500,000 miles
- Unsure

Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires? Yes Is Selected

What additional number of years does your extended warranty package cover?

- 1 year
- 2 years
- 3 years
- 5 years
- 7 years
- Other (Please Indicate) \_\_\_\_\_
- Unsure

Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires? Yes Is Selected

What does your extended warranty package cover? Check all that apply.

- Bumper to bumper
- Powertrain coverage: cylinder block, head, all internal parts, flywheel, and intake manifold, transmission case and all internal parts, etc.
- Emissions coverage: filters, catalyts, EGR, etc.
- Maintenance: lubrication, cooling, brakes, belts, filters, HVAC, etc.
- Other: (please indicate) \_\_\_\_\_
- Unsure

Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires? Yes Is Selected

Does your extended warranty package cover parts AND labor?

- Yes, it covers both parts AND labor
- No, it covers parts only
- No, it covers labor only
- Unsure

Display This Question:

If Do you have an extended warranty that covers repairs after the manufacturer-provided warranty expires? Yes Is Selected

Does the dealer or a third party provide your extended warranty package?

- Extended warranty provided by dealer
- Extended warranty provided by a third party
- Unsure

Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime?

- Yes
- No
- Unsure

Display This Question:

If Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime? Yes Is Selected

What did the repairs cost (even if they were covered under warranty)?

- Less than \$1,500
- \$1,500 – \$3,999
- \$4,000 – \$7,999
- \$8,000 – \$10,999
- \$11,000 - \$14,999
- \$15,000 - \$20,000
- Other (please indicate) \_\_\_\_\_
- Unsure

Display This Question:

If Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime?

Yes Is Selected

Were these repair costs covered under warranty?

- Yes
- No
- Only partially covered
- Unknown

Display This Question:

If Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime?

Yes Is Selected

Approximately how long was your truck out of commission?

- 1 – 2 days
- 3 – 6 days
- 1 – 2 weeks
- 3 - 4 weeks
- More than 1 month
- Unsure

Display This Question:

If Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime?

Yes Is Selected

What was the nature of the repair (i.e., parts that needed to be fixed or replaced)? Select all that apply.

- glow plugs
- pistons
- turbo chargers
- valves
- fuel injectors
- fuel rails
- computer
- axles
- wheels
- induction systems
- climate control
- particulate filters
- catalyts
- EGR
- OBD
- sensors
- fluid leaks
- Other (please indicate) \_\_\_\_\_

Display This Question:

If Has your truck ever needed repairs (not caused by an accident) that resulted in extended downtime?

Yes Is Selected

How much did the downtime cost you in income (lost revenue) even if the repairs were covered under warranty?

- \$0
- \$1 – \$999
- \$1,000 - \$4,999
- \$5,000 - \$7,499
- \$7,500 – \$9,999
- More than \$10,000 (please indicate) \_\_\_\_\_
- Unsure

Has your truck ever had the engine rebuilt or replaced?

- Yes. Rebuilt
- Yes. Replaced
- No. Original engine and parts in use
- Unsure

Condition: No. Original engine and par... Is Selected. Skip To: As a thank you for your participation...

Condition: Unsure Is Selected. Skip To: As a thank you for your participation...

Approximately how many miles were on the truck when it's engine was rebuilt or replaced?

- Less than 500,000 miles
- 500,000 – 649,999 miles
- 650,000 – 799,999 miles
- 800,000 – 949,999 miles
- 950,000 – 1,100,000 miles
- More than 1,100,000 miles
- Unsure

How old was your truck when it's engine was rebuilt or replaced?

- Less than 3 years
- 3 – 5 years
- 6 – 7 years
- 8 – 9 years
- 10 - 11 years
- More than 11 years
- Unsure

Based on your experience, how long do you think manufacturers should be required to cover the cost of repairs for new heavy-duty trucks in the future? Check one:

- 100,000 miles
- 200,000 miles
- 300,000 miles
- 400,000 miles
- 500,000 miles
- Other (please indicate) \_\_\_\_\_

# Appendix C | Repair Shop Interview Survey

## Repair Shop Manger Survey (offered in English and Spanish)

Hello,

Does your shop repair heavy-duty diesel vehicles? Can someone at your shop answer some quick questions about the cost and time it takes to work on these vehicles? *When you get to the person you need to talk to:* Do you have just a few minutes to answer a couple of quick questions about the vehicles that you work on? *NOTE: As an alternative to answering over the phone- we can offer them the web address/survey link of the ISR website to take the survey online.*

Are you 18 years or older?

- Yes
- No

Display This Question:

If Are you 18 years or older? No Is Selected

Participants must be 18 years or older to participate in this interview. Thank you for your time!

Skip To: End of interview If 18end- (1) Is Displayed

Is this shop an independent repair shop or it is attached to/affiliated with a dealership?

- Independent (1)
- Dealer affiliated (2)
- Other (3) \_\_\_\_\_

Please select the type of truck manufacturer's engine on which you primarily work (Select up to the 3 most common)

Drag and drop the top 3 most common engines on which you work
_____ Cummins
_____ Volvo
_____ Isuzu Motors
_____ Detroit
_____ Navistar
_____ Paccar
_____ Caterpillar
_____ Other (please indicate)

Select the class rate that you/your repair shop work on most frequently – if you work on more than one, select the class you work on most often.

- Class 8 (GVWR Greater than 33,000 lbs) (1)
- Class 6 and 7 (GVWR 19,501 to 33,000 lbs) (2)
- Class 4 and 5 (GVWR 14,000 to 19,500 lbs) (3)
- None of the above (99)

Skip To: End of interview If GVWR = None of the above (4)

Miles In your repair shop, what is the most common year of truck to come in for repairs?

- Before 2007
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- Don't Know/Unsure

What is the average odometer reading on trucks that come in for repairs? \_\_\_\_\_

How satisfied do you think customers are with their mandatory warranty?

- Very satisfied
- Satisfied
- Dissatisfied
- Very dissatisfied
- Don't Know/Unsure

With regard to extended warranties, according to your knowledge, do repair shops provide extended warranties?

- Yes
- No
- Don't Know/Unsure

Display This Question:

If With regard to extended warranties, according to your knowledge, do repair shops provide extended... Yes Is Selected

Does your repair shop provide an extended warranty that covers repairs after the manufacturer-provided warranty expires?

- Yes, this repair shop provides an extended warranty
- No, this repair shop does not provide an extended warranty

Does your repair shop conduct repair services on vehicles with extended warranties?

- Yes
- No

Display This Question:

If Does your repair shop provide an extended warranty that covers repairs after the manufacturer-pro... Yes, this repair shop provides an extended warranty Is Selected

What is the cost of the extended warranty package purchased or provided most frequently?

- Free or Low Cost
- \$250 - \$999
- \$1,000 – \$2,500
- \$2,501 - \$5,000
- More than \$5,000



Display This Question:

If What is the cost of the extended warranty package purchased or provided most frequently? Free or Low Cost Is Selected

Under what circumstances does your shop provide a free/low cost extended warranty?

Drag and drop response here
<input type="checkbox"/> Customer is a first time buyer
<input type="checkbox"/> Customer has a large fleet of vehicles
<input type="checkbox"/> Customer frequents our repair shop/dealership
<input type="checkbox"/> Customer provided a large down payment
<input type="checkbox"/> Other (please specify)

Display This Question:

If Does your repair shop provide an extended warranty that covers repairs after the manufacturer-pro...  
Yes, this repair shop provides an extended warranty Is Selected

On average, how many miles does your most frequently purchased or provided extended warranty package cover?

- Less than 100,000 miles
- an additional 100,000 – 200,000 miles
- an additional 200,001 – 300,000 miles
- an additional 300,001 – 400,000 miles
- an additional 400,001 – 500,000 miles
- More than 500,000 miles

Display This Question:

If Does your repair shop provide an extended warranty that covers repairs after the manufacturer-pro...  
Yes, this repair shop provides an extended warranty Is Selected

What additional number of years does your extended warranty package cover?

- Less than 1 year
- 1 year
- 2 years
- 3 years
- 4 years
- 5 years
- 6 years
- 7 years
- More than 7 years

Display This Question:

If Does your repair shop provide an extended warranty that covers repairs after the manufacturer-pro...  
Yes, this repair shop provides an extended warranty Is Selected

What does your extended warranty package cover? Drag and drop all that apply.

Drag items covered under extended warranty here
<input type="checkbox"/> Bumper to bumper
<input type="checkbox"/> Powertrain coverage: cylinder block, head, all internal parts, flywheel, and intake manifold, transmission case and all internal parts, etc.
<input type="checkbox"/> Emissions coverage: filters, catalyts, EGR, etc.
<input type="checkbox"/> Maintenance: lubrication, cooling, brakes, belts, filters, HVAC, etc.
<input type="checkbox"/> Other (please specify)

Display This Question:

If Does your repair shop provide an extended warranty that covers repairs after the manufacturer-pro... Yes, this repair shop provides an extended warranty Is Selected

Regarding parts and labor, what does your extended warranty package cover?

- Both parts AND labor
- Only parts
- Only labor
- Other (please specify) \_\_\_\_\_

Estimate For trucks less than 6 years old that need repairs (not caused by an accident), what is the estimated consumer repair cost per truck for each year of truck ownership based on your service records or other information? (i.e., 1st year repair costs, 2nd year repair costs, etc.)

	\$0 \$499	\$500 \$999	\$1,000 \$1,999	\$2,000 \$3,999	\$4,000 \$4,999	\$5,000 \$5,999	\$6,000 \$6,999	\$7,000 \$7,999	More than \$8,000	Don't Know/Unsure
1st Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2nd Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3rd Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4th Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5th Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In your experience, what percentage of repair costs are typically covered under warranty?

Slide to indicate % typically covered 

Approximately, how long does it take for repairs to be conducted at your shop?

- 1 – 2 days
- 3 – 6 days
- 1 – 2 weeks
- 3 - 4 weeks
- More than 1 month
- Don't Know/Unsure

Repair In order of frequency, please drag and drop the top 5 repairs most often provided by your repair shop.

Top 5 most frequent repairs in order from 1 to 5: 1 being most frequent repair	
_____ glow plugs	
_____ pistons	
_____ turbo chargers	
_____ valves	
_____ fuel injectors	
_____ fuel rails	
_____ computer	
_____ diesel particulate filters (DPF)	
_____ catalysts	
_____ FCR related repairs	
_____ EGR	
_____ sensors	
_____ fluid leaks	




In your experience, at what mileage (on average) will you have to replace or rebuild an engine?

- Less than 100,000 miles
- 100,000-249,999 miles
- 250,000-499,999 miles
- 500,000 – 649,999 miles
- 650,000 – 799,999 miles
- 800,000 – 949,999 miles
- 950,000 – 1,100,000 miles
- More than 1,100,000 miles
- Don't Know/Unsure/Don't Rebuild Motors

In your experience, how old is a truck (on average) when its engine needs to be rebuilt or replaced?

- Less than 1 year
- 1 year
- 2 years
- 3 years
- 4 years
- 5 years
- 6 years
- 7 years
- 8 years
- 9 years
- 10 years
- 11 years
- More than 11 years
- Don't Know/Unsure/Don't Rebuild Motors

Based on your experience, for how many miles do you think manufacturers should be required to cover the cost of repairs for new heavy-duty trucks in the future? (Please respond in thousands)

Class 4 and 5 engines (GVWR 14,000-19,500 lbs)	
Class 6 and 7 engines (GVWR 19,501-33,000 lbs)	
Class 8 engines (GVWR greater than 33,000 lbs)	

## Appendix D | Trucking Service Industry Codes (SICs)

- 1521 Single-family Housing Construction
- 1522 Residential Construction
- 1531 Operative Builders
- 1541 Industrial Buildings and Warehouses
- 1542 Nonresidential Construction
- 1611 Highway and Street Construction
- 1622 Bridge, Tunnel, and Elevated Highway
- 1623 Water, Sewer, and Utility Lines
- 1629 Heavy Construction
- 1711 Plumbing, Heating, Air-conditioning
- 1721 Painting and Paper Hanging
- 1731 Electrical Work
- 1741 Masonry and Other Stonework
- 1742 Plastering, Drywall, and Insulation
- 1743 Terrazzo, Tile, Marble, Mosaic Work
- 1751 Carpentry Work
- 1752 Floor Laying and Floor Work
- 1761 Roofing, Siding, and Sheet metal Work
- 1771 Concrete Work
- 1781 Water Well Drilling
- 1791 Structural Steel Erection
- 1793 Glass and Glazing Work
- 1794 Excavation Work
- 1795 Wrecking and Demolition Work
- 1796 Installing Building Equipment
- 1799 Special Trade Contractors