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NSTSCE

National Surface Transportation Safety Center for Excellence

Large Truck Technology Return-on-Investment Calculator: User Guide and Instruction Manual

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Technology Impairment Mobility Infrastructure

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DISCLAIMER

This return-on-investment (ROI) calculator and user guide is for informational purposes only. Although this calculator uses the benefit-cost analysis recommendation by the Federal government, each company may have criteria not contained herein that are critical to technology evaluation and purchasing decisions. All information used in these calculations is based on research data that may reflect every fleets’ operations, crashes, and drivers.

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LIST OF ABBREVIATIONS AND SYMBOLS

AAAFTS	AAA Foundation for Traffic Safety
AEB	automatic emergency braking
AST	advanced safety technology
BCR	benefit-cost ratio
LDW	lane departure warning
MACRS	Modified Accelerated Cost Recovery System
NPV	net present value
OSM	onboard safety monitoring
PDO	property damage only
ROI	return-on-investment

CHAPTER 1. WHY SHOULD YOU CONSIDER PURCHASING AN ADVANCED SAFETY TECHNOLOGY?

In 2015, large trucks were involved in 415,000 crashes in the United States that resulted in approximately 116,000 injuries and 4,067 fatalities.[(1)] One way to reduce these crashes and their resulting injuries and fatalities is through the adoption of advanced safety technologies (ASTs). Although there are a wide range of ASTs, there have been very few studies to independently evaluate their effectiveness at preventing or mitigating crashes. ASTs that have been independently evaluated in revenue-producing operations or by using real-world carrier crash data include automatic emergency braking (AEB), lane departure warning (LDW), and video-based driver onboard safety monitoring (OSM). A recent study completed by the AAA Foundation for Traffic Safety (AAAFTS) found AEB, LDW, and video-based OSM systems to be cost-effective on the societal level if installed in all U.S. large trucks, as long as the current pricing and higher effectiveness rates were realized. [(2,3,4)] This chapter summarizes the background research from the AAAFTS studies.

Example ASTs

- Automatic emergency braking
- Adaptive cruise control
- Lane departure warning
- Blind spot warning
- Lane centering steering
- Electronic stability control
- Speed limiters
- Video-based onboard driver monitoring systems
- Kinematic-based onboard driver monitoring systems
- Vehicle-to-vehicle communications
- Platooning systems
- Air disc brakes
- Brake stroke monitoring

Despite studies showing that these ASTs effectively prevent or mitigate crashes, carriers often lack data on their associated return-on-investment (ROI). The Large Truck Technology ROI Calculator will use (1) AST effectiveness rates and (2) costs recommended by a group of industry experts to provide this information.[(2,3,4)] Conservative effectiveness rates and costs were chosen in order to reflect realistic expectations you may experience during revenue-producing operations. However, the calculator also provides you the ability to adjust effectiveness rates and costs to test their impact at different levels.

AUTOMATIC EMERGENCY BRAKING

Large truck AEB systems are designed to mitigate or prevent a rear-end collision where the large truck strikes a lead vehicle. AEB systems combine at least one forward-facing sensor (e.g., radar, LIDAR, and/or camera); a driver interface with visual, audible, and/or haptic alerts; and automatic truck braking.

Expert-Recommended Conservative Estimates[(2)]

- Prevent between 16% and 28% of large truck striking rear-end crashes
- Cost: $2,500 per vehicle

AEB systems work by first identifying and tracking a lead vehicle. Once the truck moves to within a preset distance or time-to-collision with the lead vehicle, the truck driver receives a warning alert. Depending on the system, the driver may receive an audible, visual, and/or haptic warning. In response to this warning, the driver can decide to reduce speed and/or change lanes to avoid a collision with the lead vehicle. If the driver does not slow down or change lanes, the AEB system will apply the truck's brakes once a subsequent preset time-to-collision or distance is reached.

Research has shown AEB systems may prevent 16% to 52.3% of all rear-end crashes where the large truck strikes a lead vehicle.[5,6,7,8,9] Differences in study design and variations in AEB capabilities (i.e., added capability to brake for stationary objects, 0.3 g to 0.6 g braking) between different generations of AEB systems contributed to the wide range of effectiveness. Additionally, carriers and AEB technology providers have claimed higher rates of reduction in rear-end crashes.[10] In general, the costs of AEB systems range from $2,400 to $2,600 per vehicle.[8,11]

LANE DEPARTURE WARNING

LDW systems are designed to prevent crashes that result from the truck deviating outside its lane, such as truck-initiated sideswipes, run-off-road crashes, and to a lesser extent, truck-initiated head-on collisions. LDW systems use a camera(s) to monitor the truck's position on the roadway, tracking the lane line markings to determine if the truck unintentionally deviates from the lane. Typically, LDW systems provide direction-specific audible or haptic warnings depending on which lane line the truck will cross. For example, the sound of a rumble strip will be played through the right speaker if the truck crosses the right lane line. Unlike AEB, LDW systems do not actively assume control of the truck. Instead, they simply alert the driver when the truck begins to deviate from the lane without using a turn signal. These systems are designed to provide the driver with feedback about possible conflicts with other vehicles/objects or unsafe driving.

There has been a significant amount of research examining the effectiveness of LDW in preventing large truck crashes. Overall, this research has shown that LDW systems may prevent between 13% and 53% of large-truck-initiated sideswipe, run-off-road, and head-on crashes.[5,6,8,12,13,14,15,16,17,18,19] However, LDW providers have claimed that these systems can prevent up to 75% of lane departures.[20] The costs for LDW systems have been reported to range from $300 to $2,000 per vehicle.[8,14,15,18,21]

Expert-Recommended Conservative Estimates[3]

- Prevent between 30% and 47.8% of large truck initiated sideswipe, run-off-road, and head-on crashes
- Cost: $1,000 per vehicle

VIDEO-BASED DRIVER ONBOARD SAFETY MONITORING SYSTEM

Unlike AEB and LDW, video-based OSM systems are not designed to prevent a specific type of crash. Instead, video-based OSM systems are safety tools that allow carriers to efficiently and effectively coach drivers. If carriers follow best practice guidance regarding the effective introduction of the system and coaching of drivers, these systems have the potential to reduce the overall number of preventable crashes caused by driver error or behaviors.

Video-based OSM systems use in-vehicle video cameras and sensors (e.g., accelerometers) to continuously monitor driver performance. The combination of video and sensor data provides objective information to pinpoint safe and unsafe driving behaviors. Typically, these systems use two cameras (one forward-facing camera and one driver-facing camera), though some systems incorporate fewer or more cameras. If a potentially unsafe event is detected by the camera or sensors, the video-based OSM system saves a predetermined amount of data surrounding the event (e.g., 30 seconds prior and 30 seconds after the event). Depending on the video-based OSM provider, these data are processed and either sent to the carrier for review, or as is more common, are reviewed by experts at the technology provider, which then sends a summary of the event (along with the video) to the carrier for review. This review results in detailed information surrounding the event and creates actionable data that the carrier can use to coach drivers.

There are few independent evaluations examining the effectiveness of video-based OSM systems. Research has shown that these systems may prevent between 52.2% and 59.1% of safety-critical events.(22) However, many carriers have reported much higher reductions in crashes.(23,24) Although the effectiveness data is limited, video-based OSM systems were included in the calculator due to the large number of crashes that could be prevented with the effective introduction and use of the technology, as well as increased carrier interest in purchasing these systems.

Expert-Recommended Conservative Estimates(4)

- Prevent between 20% and 52.2% of preventable large truck crashes related to driver error
- Costs: $525 (hardware), $40 monthly fee, and driver coaching

The cost structure for video-based OSM systems is substantially different from the cost structure for AEB and LDW systems. The largest cost associated with AEB and LDW are the hardware costs. However, the largest video-based OSM system costs are associated with driver coaching. Based on discussions with technology providers, the per-vehicle costs of video-based OSM systems include $300 to $600 for hardware, $0 to $150 for installation, $20 to $60 per month service fee, and costs associated with driver coaching, which averages 10 minutes per driver per coaching session. During the first 2 months after installation, approximately 25% of drivers receive coaching, and after 1 to 2 months this number drops to 1% of drivers who require coaching. On average, one manager is responsible for coaching 75 drivers.

CHAPTER 2. COST OF LARGE TRUCK CRASHES

There are a number of factors that influence the total cost of large truck crashes. These costs include:

- Labor and worker's compensation costs
- Operational costs
- Environmental costs
- Property damage costs
- Legal costs
- Settlement/out-of-pocket costs

The American Transportation Research Institute (ATRI) collected average crash cost data from large truck insurers, agencies specializing in large truck crash litigation, and motor carriers. The cost estimates used in the calculator are based on ATRI's average crash cost estimates. The average costs by severity are shown in Table 1.

Table 1. Average costs of large truck crashes by severity.

Crash Severity	Average Crash Cost
Property-damage-only (PDO) Crash	$43,124
Injury Crash	$217,675
Fatal Crash	$4,340,160

CHAPTER 3. HOW COSTS AND BENEFITS ARE USED TO CALCULATE ROI

Below is a high-level overview of the calculations used to estimate the ROI you may experience if deploying AEB, LDW, or video-based OSM systems. These calculations include identifying the technology and deployment costs of the ASTs, crash avoidance benefits, the net present value (NPV), the benefit-cost ratio (BCR), and payback period. These are included so you understand what costs were included in each variable and how the ROI was calculated.

TECHNOLOGY AND DEPLOYMENT COSTS

Calculating the technology and deployment costs of ASTs needs to include both non-recurring and recurring costs. Non-recurring costs include the initial cost of the equipment, installation, and initial training. Recurring costs include system maintenance and ongoing training. The following formula was used to calculate AST technology and deployment costs. In the formula below, y is the year.

$$Total\ Cost_y = Technology_y + Installation_y + Training_y + Maintenance_y$$

IDENTIFY CRASH AVOIDANCE BENEFITS

To calculate ROI, you need to calculate the relative safety impacts associated with the deployment of an AST. This requires you to calculate the costs of crashes as if (1) no ASTs are installed on the trucks and (2) ASTs are installed on the trucks. This calculation uses the average cost of AST-related crashes described in the previous section and the crash rate reduction described in the first section. The following formula was used to estimate the average annual crash avoidance benefits. This formula calculates the difference in the number of crashes prevented by the AST multiplied by the cost of each crash type. In the formula below, *i* is the crash severity (e.g., PDO, injury, or fatal).

$$Crash\ Cost\ Benefits = \sum_i (Crashes\ without\ AST_i - Crashes\ with\ AST_i) * Crash\ Cost_i$$

NET PRESENT VALUE

The NPV is the net difference between the total benefits and the total costs. An NPV greater than zero indicates the AST may be a good alternative. For example, if AEB has an NPV of \$1,000, the total benefits are greater than the total costs. This indicates AEB may be cost-effective. However, if AEB has an NPV of −\$1,000, the total benefits are less than the total costs. This indicates AEB may not be cost-effective. To calculate the NPV, first use the formula below to calculate the net costs of installing the AST. As before, y is the year.

$$Net\ Cost_y = Total\ Costs\ with\ the\ AST_y - Total\ Cost\ without\ the\ AST_y$$

Next, use the formula below to calculate the expected net benefits associated with installing the AST.

$$Net\ Benefits_y = Crash\ Cost\ Benefits\ without\ the\ AST_y - Crash\ Cost\ Benefits\ with\ the\ AST_y$$

Finally, use the following formula to calculate the NPV. In the NPV formula, *r* is the discount rate. A discount rate reduces the present value of current costs for future years. The Office of Management and Budget recommends using a discount rate of 7%.[(25)] This means a higher discount rate reduces the present value of costs and benefits in future years.

$$NPV = \sum_{y=1}^{Y} \frac{(Net\ Benefits_y - Net\ Cost_y)}{(1+r)^y}$$

BENEFIT-COST RATIO

Another useful way to calculate the ROI of an AST is with a BCR. A BCR above 1.0 suggests that the expected benefits of deploying an AST outweigh the expected costs of deploying an AST. For example, if AEB has a BCR of 3.75, AEB is expected to save $3.75 for every $1.00 spent on the technology. This indicates AEB may be cost-effective. However, if AEB has a BCR of 0.69, AEB is expected to save $0.69 for every $1.00 spent on the technology. This indicates that AEB may not be cost-effective. The following formula was used to calculate the BCR. In the formula below, *n* is the number of years in the analysis (typically 5 years). The analysis period used in the formula should be long enough to experience all the benefits and costs of the AST.

$$BCR = \frac{\sum_{y=1}^{n} \frac{Net\ Benefits_y}{(1+r)^n}}{\sum_{y=1}^{n} \frac{Net\ Costs_y}{(1+r)^n}}$$

PAYBACK PERIOD

As many ASTs require a large up-front investment, you may also want to consider the length of time required before the AST benefits outweigh the initial upfront costs. In other words, you may want to know, “How long do I have to have the AST before it pays for itself?” For example, if AEB has a payback period of 15 months, it would take 15 months of the AEB system preventing crashes to overcome the total cost of AEB. The following formula was used to calculate the payback period required.

$$Payback\ Period\ in\ Months = \frac{Total\ Cost\ for\ 5\ years}{Crash\ Cost\ Benefits} * 12$$

CHAPTER 4. ROI CALCULATOR INSTRUCTIONS

To find your fleet's estimated ROI for implementing AEB, LDW, and/or video-based OSM systems, please follow the instructions below.

Step 1. Open the ROI Calculator.
Step 2. Click on the tab titled **Instructions** (Figure 1)**.** This page provides you with a high-level overview of the instructions in this document.
Step 3. Click on the tab titled **Contents** (Figure 1).

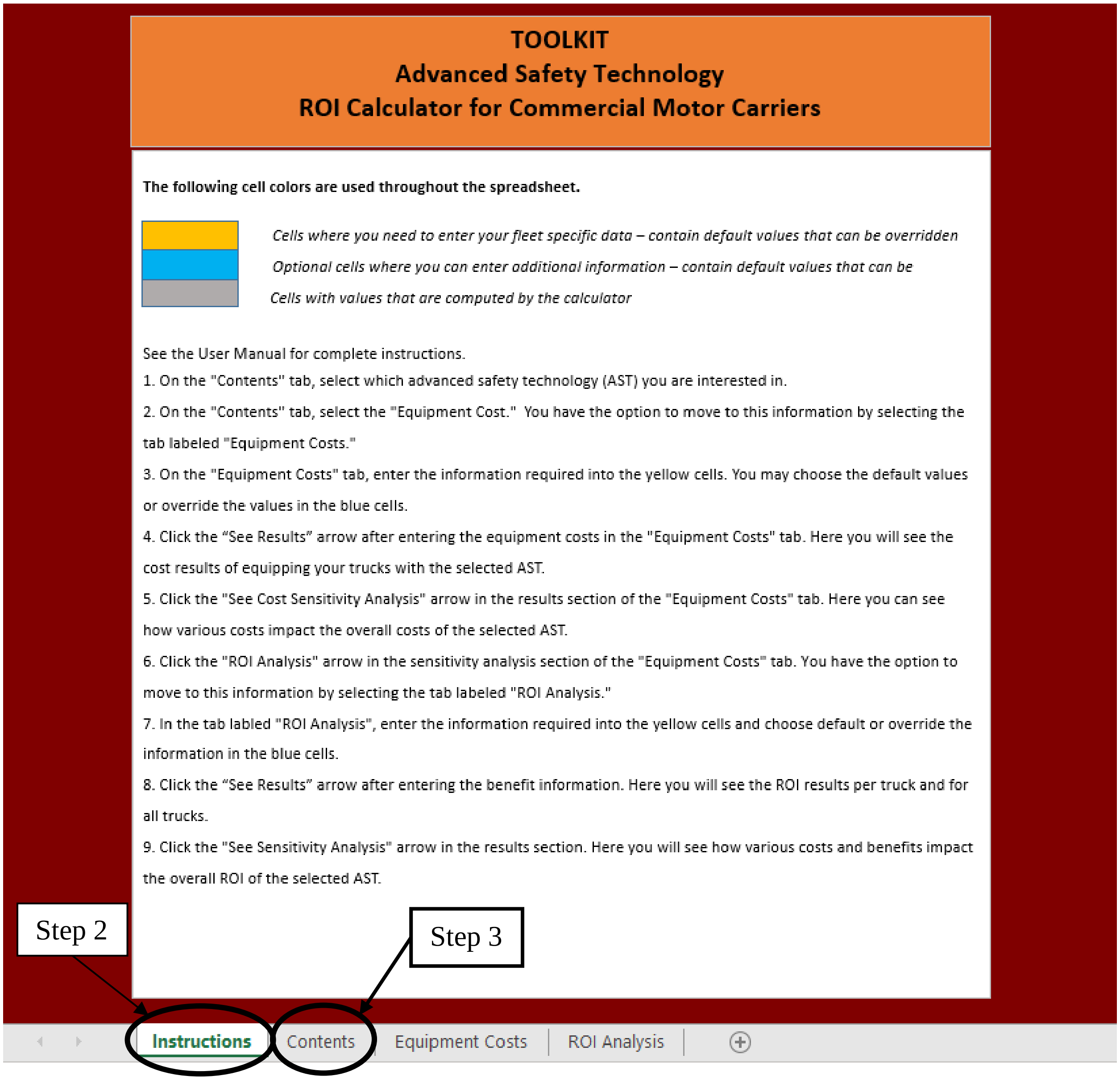

Figure 1. Screenshot. ROI Calculator: Instructions tab.

Step 4. On the **Content** tab, select the AST system you are interested in installing. Your options are AEB, LDW, and video-based OSM systems (Figure 2).

Step 5. Click on “Equipment Costs” (Figure 2). You can also navigate to the equipment costs by clicking on the **Equipment Cost** tab.

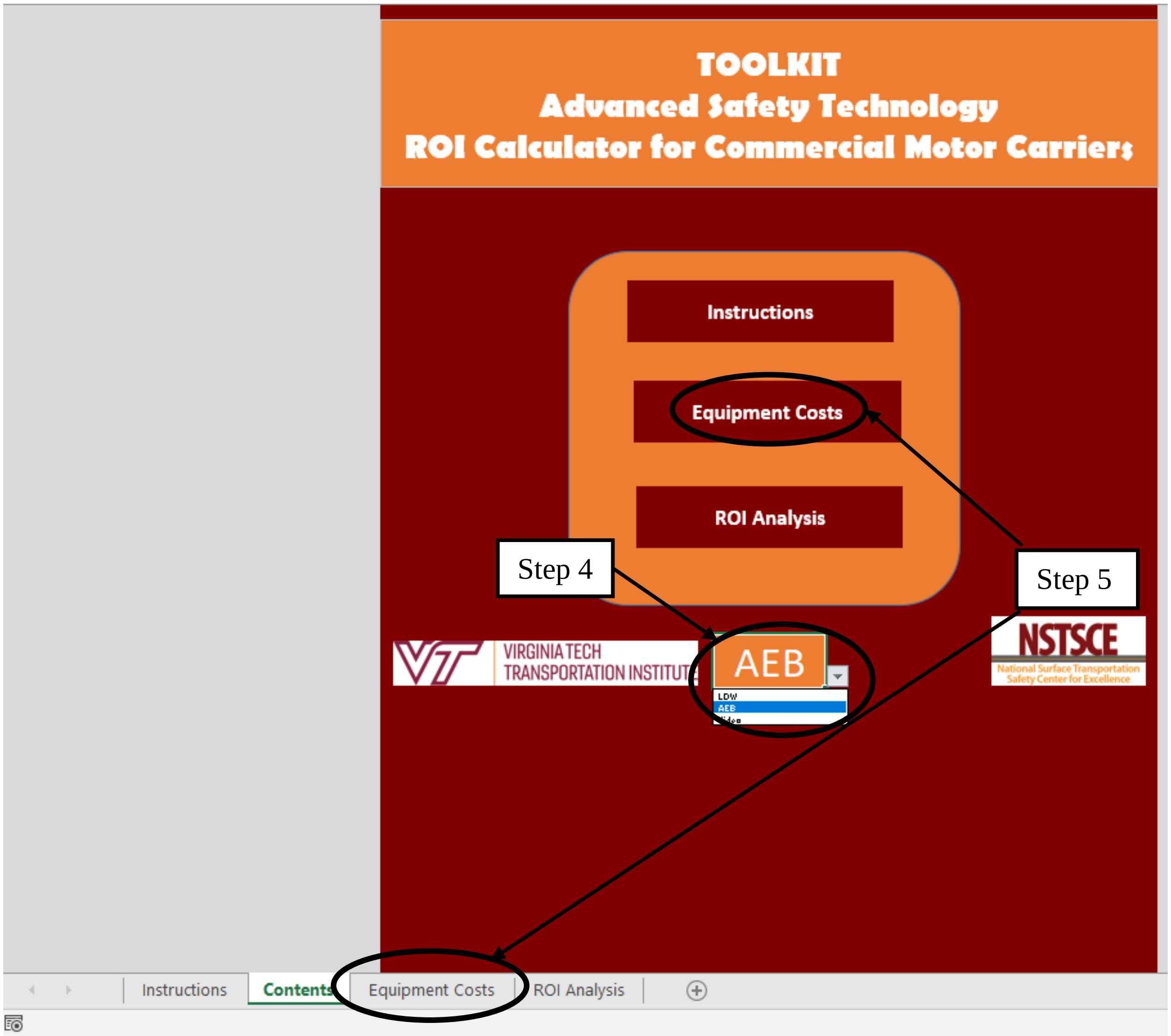

Figure 2. Screenshot. ROI Calculator: Contents tab.

ENTERING EQUIPMENT COSTS

On this page (Figures 3 and 4), you can enter all factors that influence the costs of deploying the AST. These include the purchase price, financing information (if financed), driver pay information, maintenance information, how long you expect to incur costs and benefits associated with the system, and the rate of inflation. Default values have been provided for all variables; however, you can enter new information. To reset the values, click on “Default” for the appropriate section. Alternatively, you can click “Clear all” to return all fields to their default values.

Step 1. Enter the number of trucks to be equipped with the AST.

Step 2. Decide if you would like to use the default cost for the AST. Or, enter a new cost.

Step 3. Select whether the AST will be financed. Skip to Step 9 if the AST will **not** be financed. If the AST will be financed, you can use the default values, or enter the following information:

- How many years the will AST be financed
- The annual interest rate

Step 4. Enter the Modified Accelerated Cost Recovery System (MACRS) tax depreciation rate and the depreciation schedule.

Step 5. Enter the following driver pay information or use the default values:

- Average driver pay per hour
- The percentage used to calculate drivers' fringe benefits
- The percentage used to calculate overhead costs
- The number of drivers per truck (e.g., team drivers)
- Your driver turnover rate
- The number of hours per year required to train drivers on the specific AST

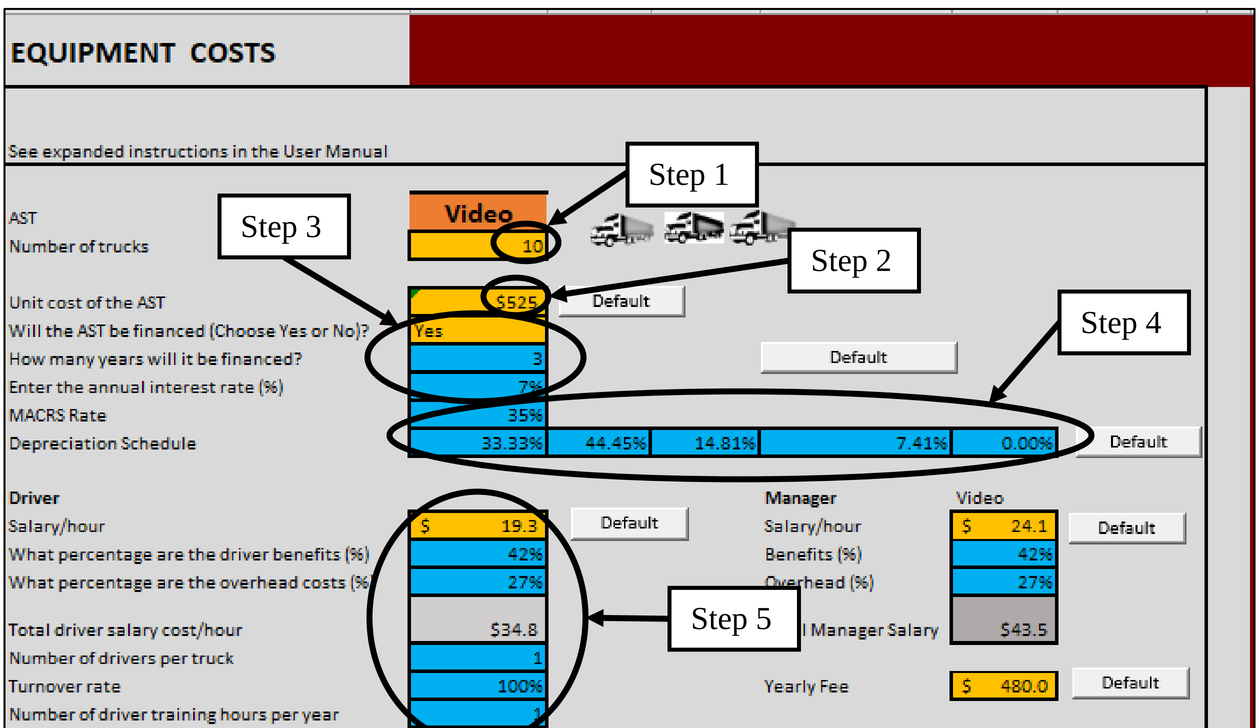

Figure 3. Screenshot. ROI Calculator: Equipment Costs tab – information entry.

Step 6. If you are entering information for video-based OSM systems, you will also need to enter the following manager pay information or use the default values (Figure 4). Skip to Step 8 if you are entering information for LDW or AEB systems.

- Average manager salary per hour
- The percentage used to calculate overhead costs
- The percentage used to calculate managers' fringe benefits

Step 7. If you are entering information for video-based OSM systems, you will also need to enter the yearly fee required for the system's services (to calculate the yearly cost, multiple the monthly fee by 12). Skip to Step 8 if you are entering information for LDW or AEB systems.

Step 8. Enter the percentage of system maintenance required each year.

Step 9. Enter any other costs you expect to incur in the AST's deployment that may not have been accounted for.

Step 10. Enter the discount rate to account for inflation. The discount rate discounts the present value of benefits and costs for future years (the Office of Management and Budget recommends a 7% discount rate).

Step 11. Click **See Results.**

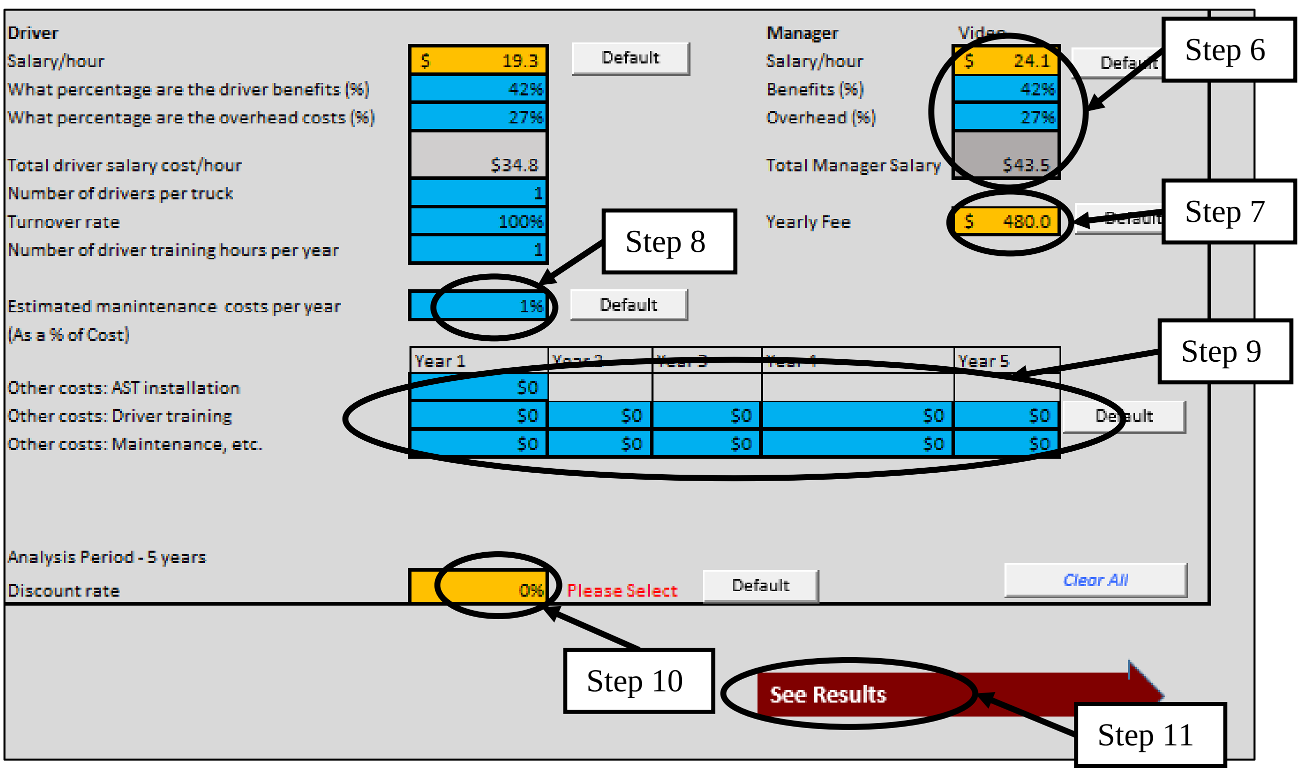

Figure 4. Screenshot. ROI Calculator: Equipment Costs tab – information entry.

RESULTS FOR EQUIPMENT COSTS

On this page (Figure 5), you will see the total equipment costs for deploying the AST system. The table and figures on the left side show the costs if the AST is not financed. The table and figures on the right side show the costs if the AST is financed.

Step 1. Choose to see the total costs for "all trucks" or "per truck." Selecting "all trucks" will provide you with the total cost for equipping all your trucks with the AST system. Selecting "per truck" will provide you with the cost to equip each truck.

Step 2. Here you can see the total equipment costs based on the information you entered. The table on the left shows the total costs if the equipment is not financed. The table on the right shows the total costs if the equipment is financed. The NPV represents the total equipment costs.

Step 3. Here you can see how much each cost factor contributes to the total equipment cost. As with the tables above, the graph on the left shows the total costs if the equipment is not financed. The graph on the right shows the total costs if the equipment is financed.

Step 4. Here you can see the total equipment costs and the individual cost factors over 5 years. Again, the graph on the left shows the costs if the equipment is not financed. The graph on the right shows the costs if the equipment is financed.

Step 5. Click **See Cost Sensitivity Analysis** to see how different costs impact the total costs.

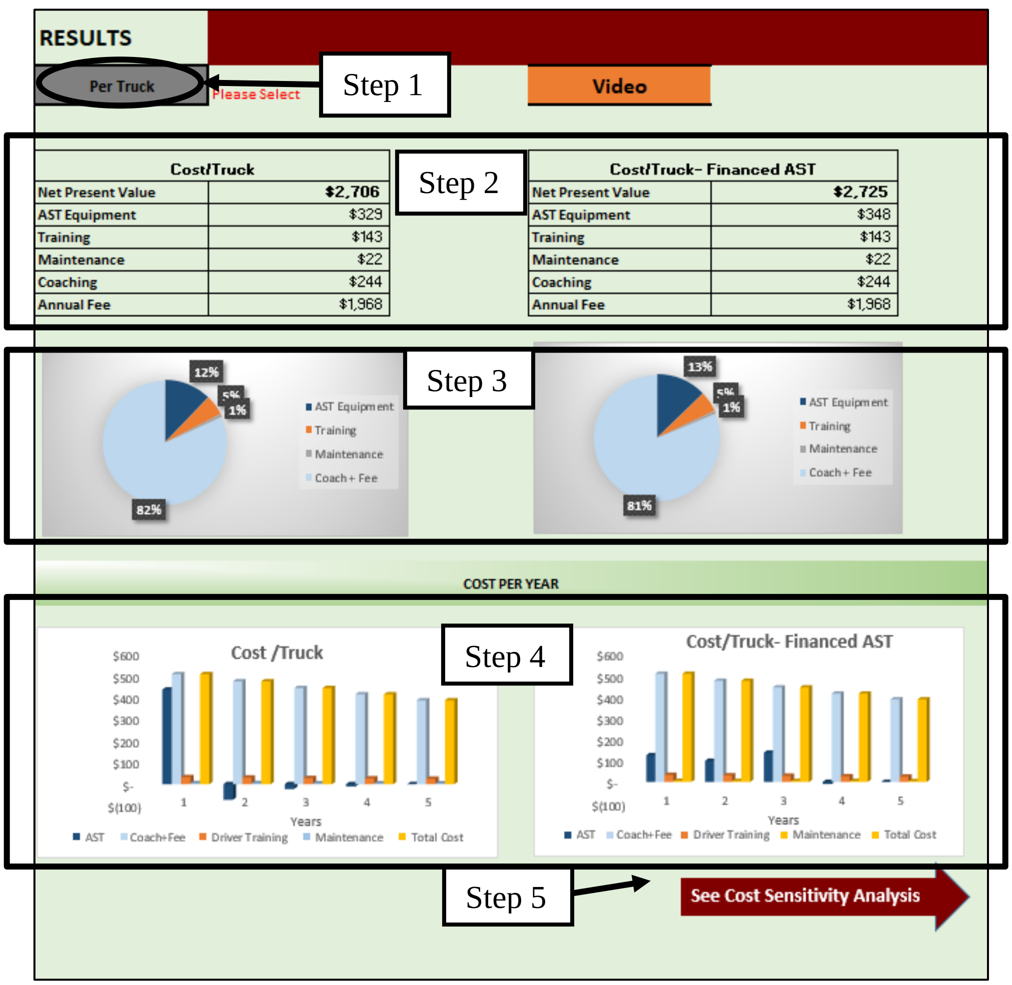

Figure 5. Screenshot. ROI Calculator: Equipment Costs tab – results.

SENSITIVITY ANALYSIS FOR EQUIPMENT COSTS

This page (Figure 6) allows you to see how different costs impact the total costs of deploying the AST system.

Step 1. Choose whether you would like to see the equipment cost sensitivity analyses for "all trucks" or "per truck."

Step 2. Here you can enter different cost values to see how they would impact total equipment costs. For each cost category, the top number shows what was previously entered. You can enter up to two alternative costs for each category.

Step 3. Here you can see how the alternative costs impact the total equipment costs. The graph on the top shows the costs if the equipment is not financed. The graph on the bottom shows the costs if the equipment is financed.

Step 4. Here you can see how each cost factor contributes to the total equipment cost for the alternative purchase prices. The top graph shows the total costs based on the original costs entered. The middle graph shows the total costs based on the first alternative purchase price entered. The bottom graph shows the total costs based on the second alternative purchase price entered.

Step 5. Click **Go to the ROI Analysis** to enter the benefits information.

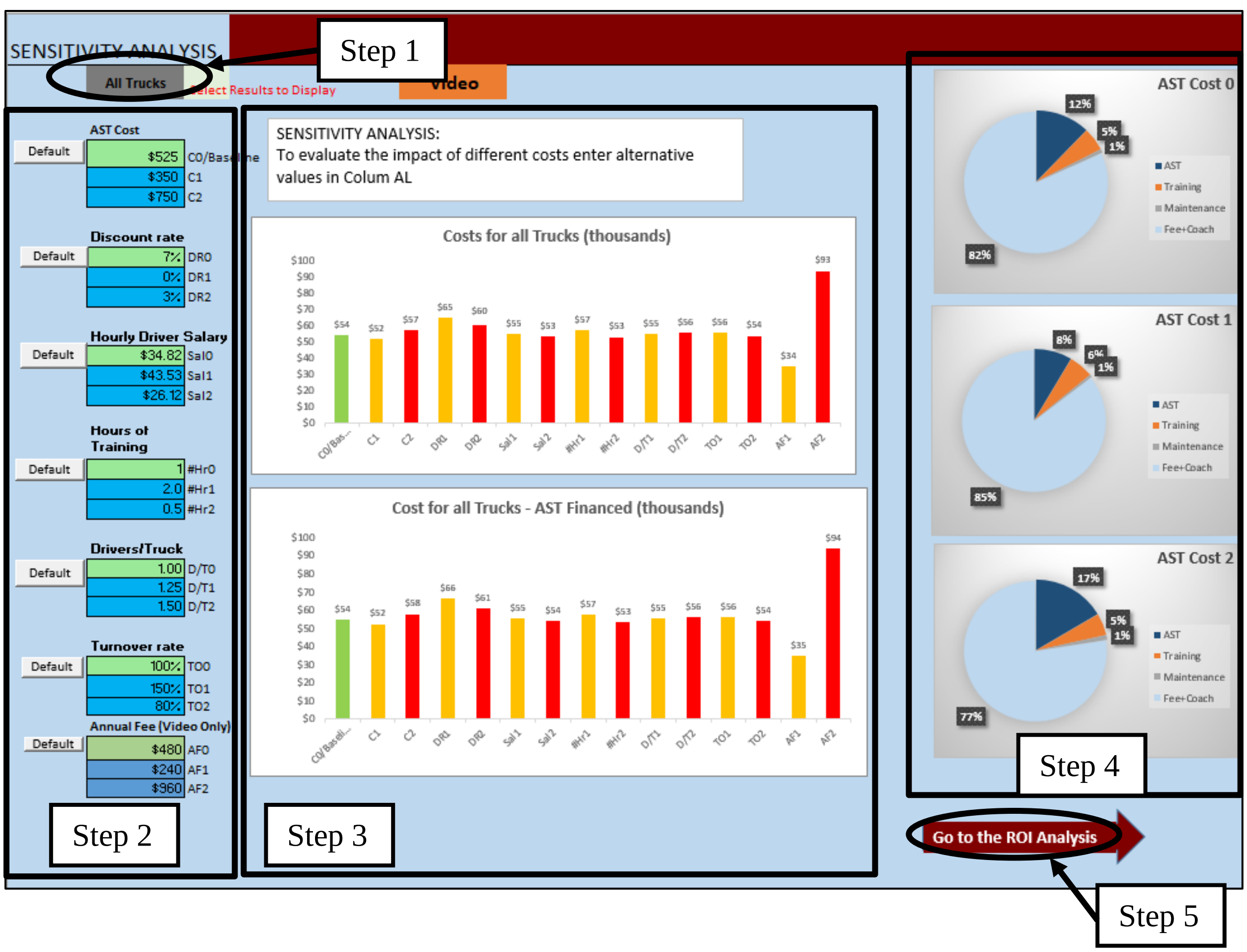

Figure 6. Screenshot. ROI Calculator: Equipment Costs tab – sensitivity analysis.

ENTERING EQUIPMENT BENEFITS

On this page (Figure 7), enter information necessary to calculate the potential benefits of deploying the AST.

Step 1. Select whether you are "self-insured" or "insured." Skip to Step 3 if you are self-insured.
Step 2. If you are insured, select your deductible amount for liability, cargo, and physical damage coverage. There are five default option levels to choose from for each type of insurance coverage.
Step 3. Enter the average yearly mileage across your entire fleet.
Step 4. If you can provide a separate number of PDO, injury, and fatal crashes (only those related to the AST of interest) select "Per Severity." If you can only provide the overall number of crashes related to the AST of interest, select "All."
Step 5. Enter the number of years over which your crash numbers were generated. For example, if you are reporting the number of rear-end truck striking crashes in the past 2 years, you would enter "2" here. If you are using the number of rear-end truck striking crashes over the last 5 years, you would enter "5."
Step 6. Click on the link Click here to enter your # of crashes.

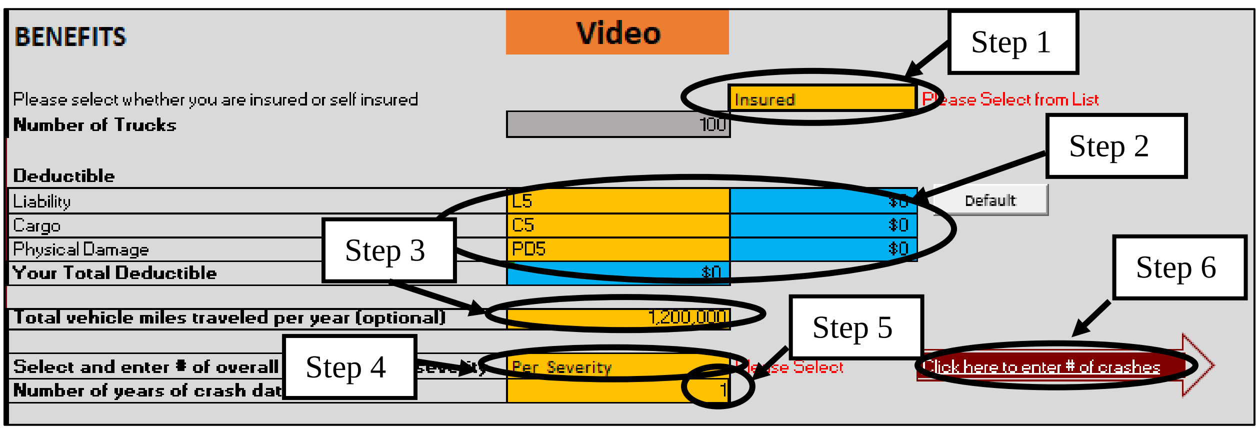

Figure 7. Screenshot. ROI Calculator: ROI Analysis Option A tab – information entry.

Step 7. If you chose to report "all crashes," enter the total number of crashes related to the AST of interest (Figure 8). These crashes include the following:

- AEB: rear-end crashes where the truck struck another vehicle
- LDW: large-truck-initiated sideswipe, head-on, and run-off-road crashes
- Video-based OSM: preventable crashes related to driver error

A. Enter your average cost per crash (for crashes related to the AST of interest) or use the default value.
B. Here you will see your total crash cost.
C. Once these steps are complete, skip to Step 9.

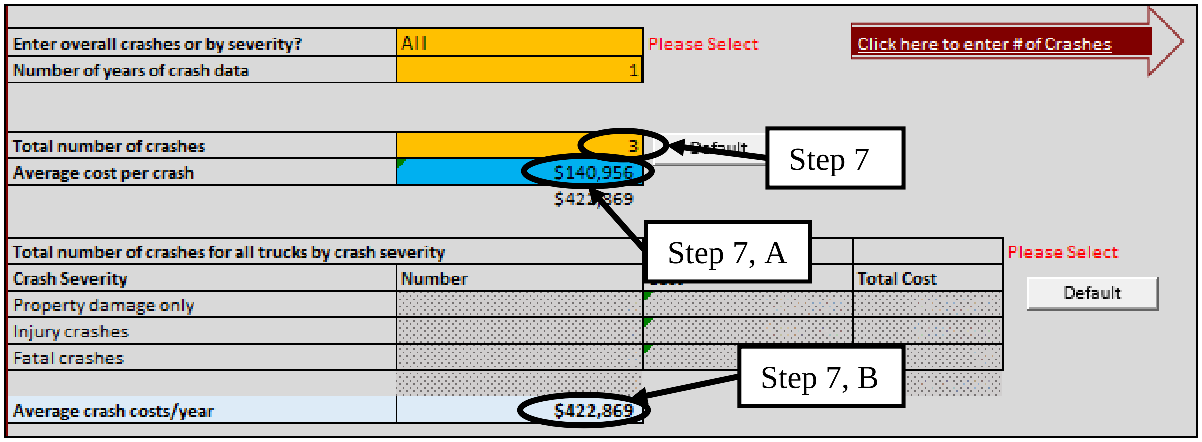

Figure 8. Screenshot. ROI Calculator: ROI Analysis Option A tab – information entry (all crashes).

Step 8. If you chose to report crashes by severity, provide the information below based on the crashes the AST of interest may prevent (Figure 9). The crashes each AST may prevent include the following:

- AEB: rear-end crashes where the truck struck another vehicle
- LDW: large-truck-initiated sideswipe, head-on, and run-off-road crashes
- Video-based OSM: preventable crashes related to driver error

A. Enter the total number of PDO, injury, and fatal crashes related to the AST of interest.
B. Enter your average cost per PDO, injury, and fatal crash (for those crashes related to the AST of interest) or use the default value.
C. Here you will see your total crash cost.

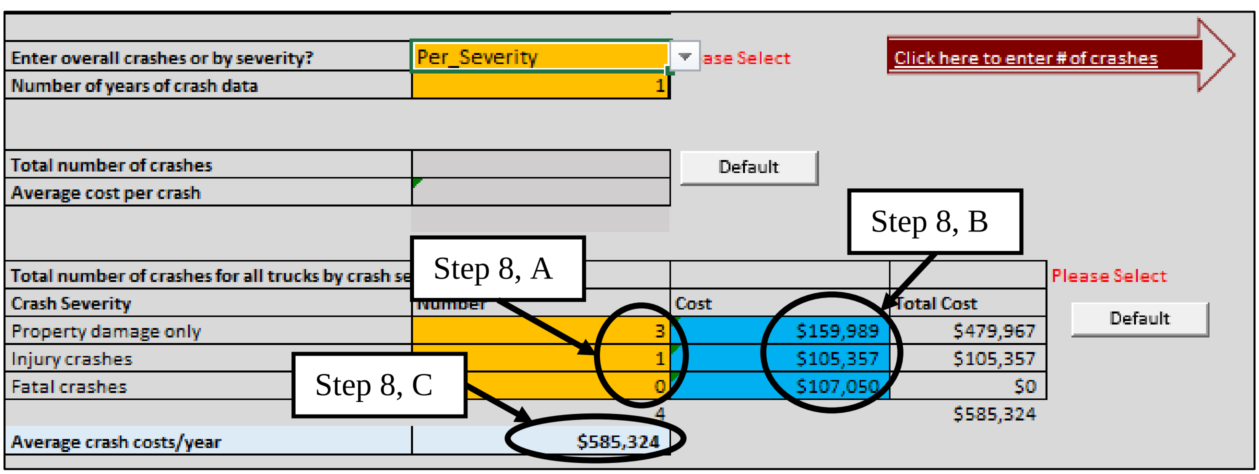

Figure 9. Screenshot. ROI Calculator: ROI Analysis Option A tab – information entry (by severity).

Step 9. Select whether you would like to use the "Low," "Average," or "High" AST effectiveness rate to calculate the percentage of crashes that deployment of the AST is expected to reduce. You also have the option to enter a new effectiveness rate (Figure 10).

Step 10. Here you will see the total expected crash costs savings associated with the deployment of the AST.

Step 11. Select if you transport high-value cargo. If you move cargo with a value over $50,000, you should select "Low" or "High." Selecting "Low" will add an additional $60,000 to your crash cost. Selecting "High" will add an additional $1,000,000 to your crash cost. Alternatively, you may enter a different amount for the additional value of your high-value cargo. You may select "No" if you do not transport high-value cargo.

Step 12. Here you will see the expected adjusted crash cost savings.

Step 13. Here you can see whether you indicated the AST was financed and the discount rate from the Equipment Cost tab.

Step 14. Click **See Results** to see your ROI results.

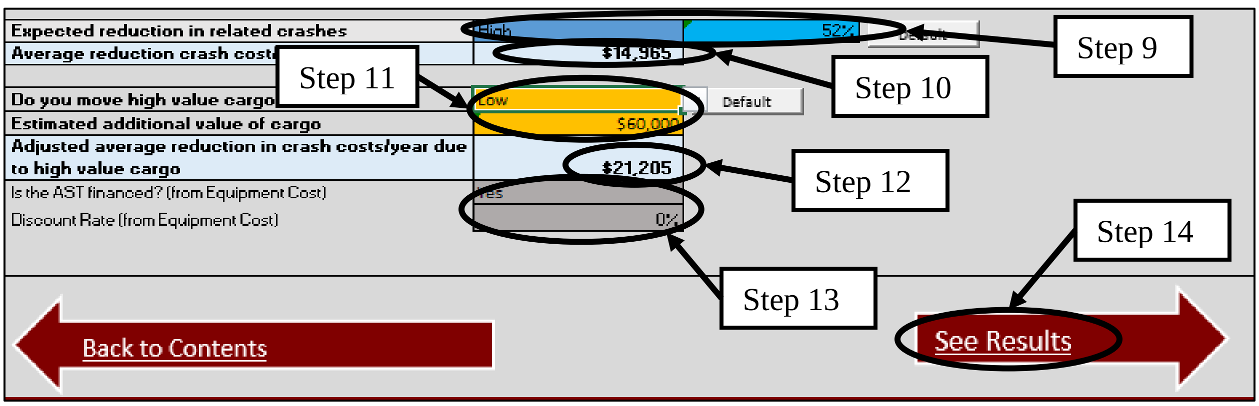

Figure 10. Screenshot. ROI Calculator: ROI Analysis Option A tab – information entry.

CHAPTER 5. HOW TO INTERPRET YOUR ROI RESULTS

Once you click **See Results**, you will see the following page (Figure 11). This page presents your estimated ROI based on all the information you provided. On this page you will see the following:

1. The ROI results for "all trucks" and "per truck."
2. A review of all the information you provided.
3. Your estimated BCR.
4. Links to change any cost or benefit inputs.
5. The amount of time it will take for you to recuperate your initial investment in the AST.
6. Two graphs showing the costs and NPV per year for *all trucks*.
7. Two graphs showing the costs and NPV per year *per truck*.
8. Your average crash costs per year for *all trucks* and *per truck*.

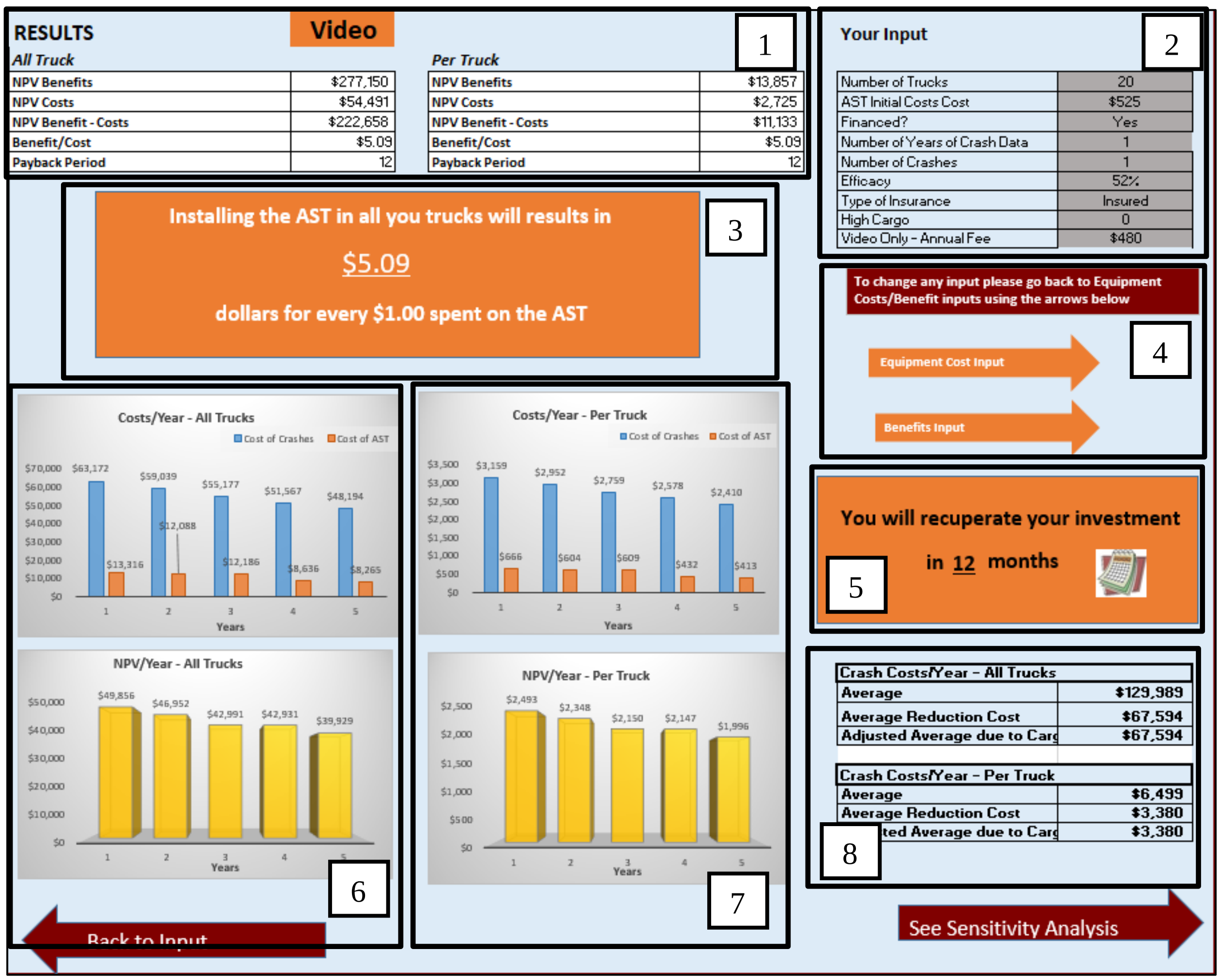

Figure 11. Screenshot. ROI Calculator: ROI results page.

A BCR above 1.00 indicates that the benefits outweigh the costs of deploying the AST. You can interpret the BCR as the dollar amount you will receive for each dollar invested. For example, a BCR of $5.09 indicates that you can expect to get $5.09 for every $1.00 you invested in the AST.

A BCR below 1.00 indicates that the costs of the AST outweigh its anticipated benefits. In other words, a BCR below 1.00 indicates you would lose money by deploying the AST based on the provided costs and effectiveness.

The other main result provides an estimate on the length of time required before your cost savings outweigh the costs of deploying the AST. For example, if your payback period is 12 months, you can expect to have recuperated your initial investment in the AST through crash reductions after 12 months.

In addition to your estimated ROI results, it is important to consider how different costs and benefits may impact the estimated ROI of deploying the AST. Click **See Sensitivity Analysis** to examine how your ROI may change given higher or lower numbers for AST effectiveness, AST cost, discount rate, and crash cost.

ROI RESULTS SENSITIVITY ANALYSIS

As mentioned above, the sensitivity analysis allows you to see how different costs and benefits impact the ROI of deploying the AST. Once you click **See Sensitivity Analysis,** the following page (Figure 12) will appear, allowing you to enter alternative costs and benefits.

- Step 1. Select whether you would like to see the ROI sensitivity analyses for all trucks or per truck.
- Step 2. Here you can enter different benefit and cost values to see how various factors would impact the AST’s ROI. For each category, the top number shows what was previously entered. You can enter up to two alternative costs for each category.
- Step 3. Here you can see how the alternative values impact the overall benefits.
- Step 4. Here you can see how the alternative values impact the overall costs.
- Step 5. Here you can see how the alternative values impact the NPV.
- Step 6. Here you can see how the alternative values impact the BCR.
- Step 7. Here you can see how the alternative values impact the payback period.
- Step 8. Click **See Sensitivity Analysis** for additional results.

Figure 12. Screenshot. ROI Calculator: Sensitivity Analysis page.

These graphs show you how altering the AST's effectiveness at reducing crashes, as well as the discount rate, system costs, and crash costs impact the crash avoidance benefits (see Step 3), the system costs (see Step 4), the NPV (see Step 5), the BCR (see Step 6), and the payback period (see Step 7).

Additionally, truck mileage greatly impacts the average number of crashes your fleet is involved in. The higher the mileage, the more crashes you can expect to avoid with the deployment of the AST. Click **Additional Sensitivity Analysis** to view how yearly mileage impacts your ROI given a higher or lower AST effectiveness, AST cost, discount rate, and crash cost.

ROI RESULTS SENSITITIVTY ANALYSIS PART II

After clicking **Additional Sensitivity Analysis**, you will see the following page (Figure 13). This page shows you how annual mileage per truck impacts your ROI. This page shows you the following information:

1. The benefit and cost values you entered on the previous page.

2. A graph showing how the BCR *per truck* per year varies based on annual miles traveled per truck.
3. A graph showing how the payback period *per truck* per year varies based on annual miles traveled per truck.
4. A graph showing how the NPV *per truck* per year varies based on annual miles traveled per truck.

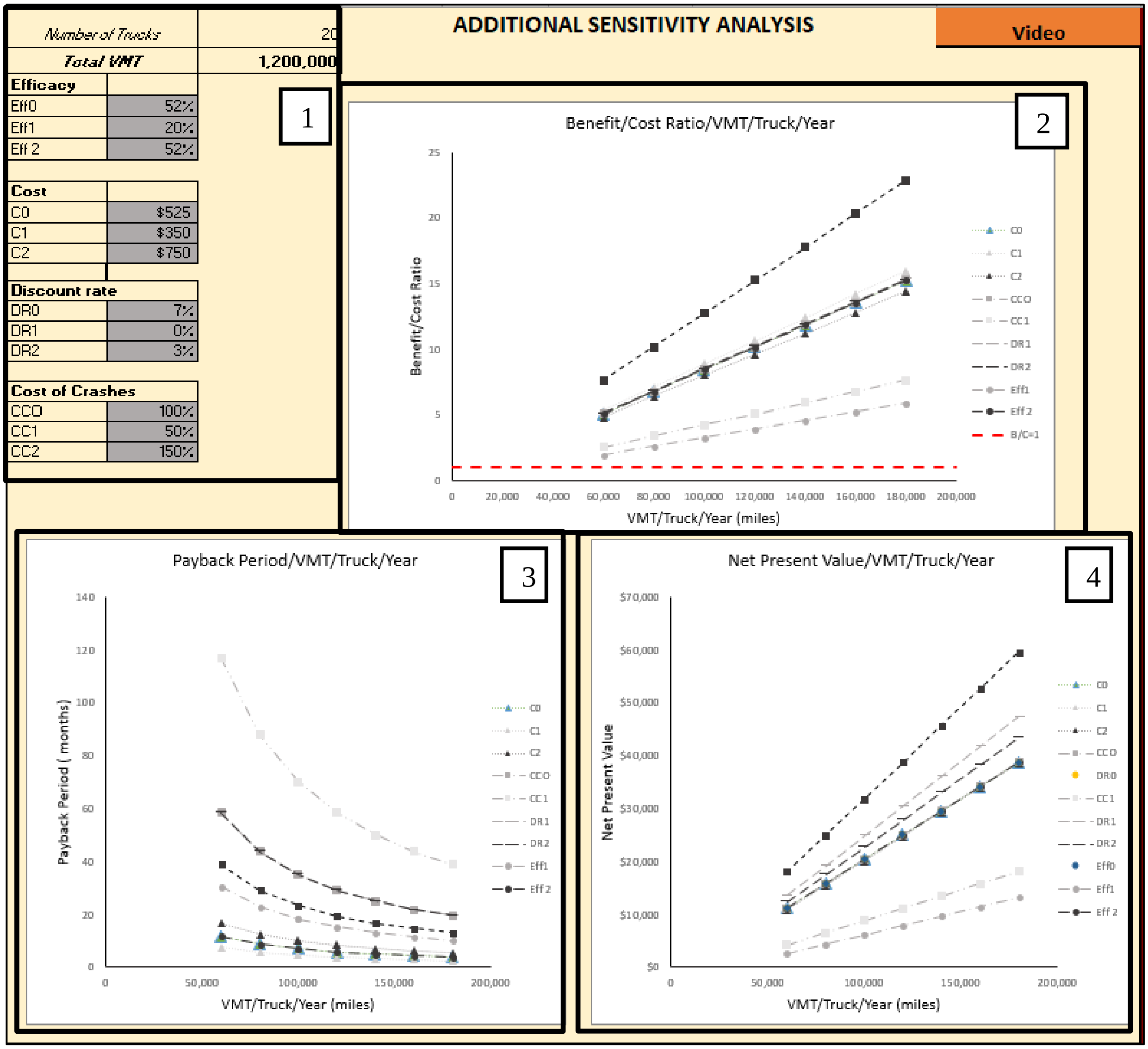

Figure 13. Screenshot. ROI Calculator: Additional Sensitivity Analysis page.

Similar to the previous sensitivity analysis, this page allows to see how your ROI may be impacted by different costs, benefits, and mileage. These graphs show you how increasing or decreasing the yearly vehicle mileage and altering the AST effectiveness at reducing crashes, discount rate, system costs, and crash costs impact the BCR (see #2), the payback period (see #3), and the NPV (see #4).

CHAPTER 6. ROI CALCULATOR REVIEW

In 2015, large trucks were involved in 415,000 crashes in the United States that resulted in approximately 116,000 injuries and 4,067 fatalities.[(1)] One way to reduce these crashes and their resulting injuries and fatalities is though the adoption of ASTs. However, adoption of ASTs has been slow in the transportation industry. One of the most frequently cited barriers to AST adoption is a lack of ROI data. This calculator provides CMV carriers with a tool to estimate the ROI you may experience if deploying AEB, LDW, or video-based OSM systems. It has been designed to allow carriers to input data specific to their fleet (e.g., number of trucks, mileage, number of crashes, etc.) to show the realistic potential benefits and costs in implementing ASTs. If carriers see a positive ROI associated with implementing ASTs, adoption of ASTs should increase. This increase in ASTs on large trucks has the potential to greatly reduce the number of injuries and fatalities on the nation's roadways.

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