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LOGISTICS MANAGEMENT INSTITUTE

National Motor Vehicle Title Information System Cost-Benefit Analysis

Project Report

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National Motor Vehicle Title Information System (NMVTIS) Cost-Benefit Analysis

Project Summary Report

June 25, 2001

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This briefing summarizes work the Logistics Management Institute (LMI) has completed for the National Institute of Justice (NIJ) regarding a cost-benefit analysis of the National Motor Vehicle Title Information System (NMVTIS).

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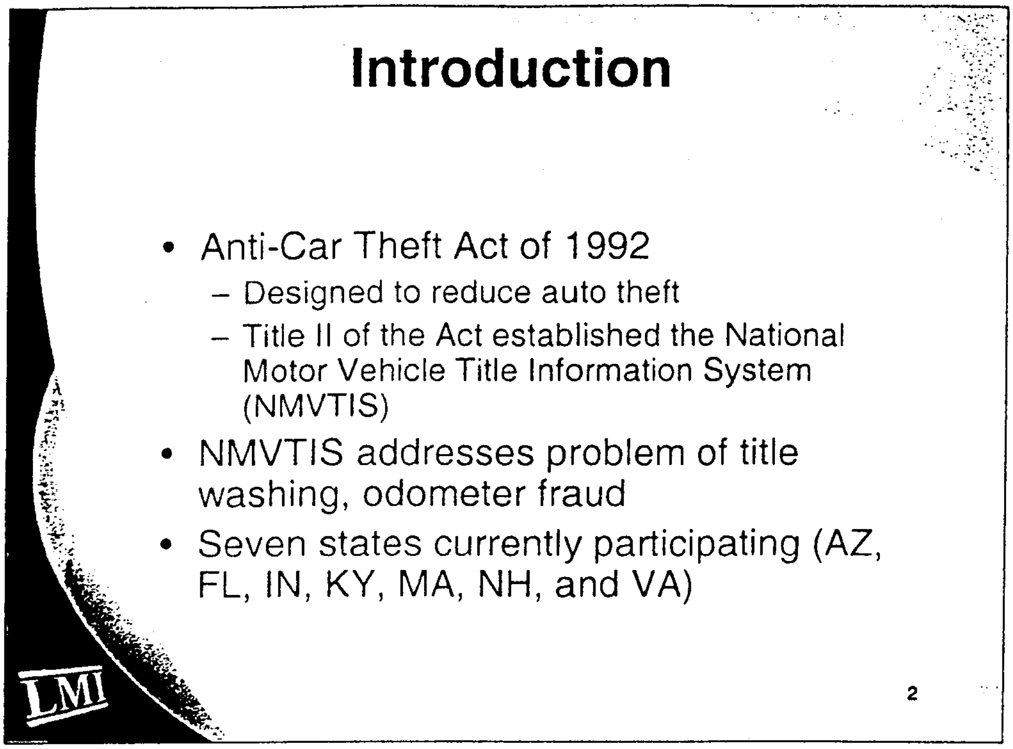

The Anti-Car Theft Act was passed in 1992 by Congress as a response to motor vehicle theft, which was viewed to be the nation's top property crime at that time. The Act was designed to reduce auto theft by making the selling of stolen cars and parts more difficult. Title II of the Act required the establishment of a national motor vehicle title information system (NMVTIS).

The Act requires that NMVTIS enable users to instantly and reliably validate motor vehicle titles during the re-titling process, and to provide a vehicle history.

NMVTIS addresses title washing and odometer fraud, among other capabilities.

Currently, seven states are participating in NMVTIS on a pilot basis: AZ, FL, IN, KY, MA, NH, and VA. However, FL and MA have not yet fully implemented NMVTIS.

Introduction (cont'd)

- In 1999, GAO recommended DoJ perform life-cycle cost benefit analysis, prior to national NMVTIS roll out
- The National Institute of Justice (NIJ) contracted with LMI to perform that analysis

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In 1999, the General Accounting Office (GAO) recommended the Department of Justice (DoJ) perform a life-cycle cost benefit analysis to determine if additional federal investment in NMVTIS was justified. The GAO recommended DoJ provide additional federal funds for NMVTIS if the cost-benefit analysis supports continued investment.

The NIJ contracted with LMI to conduct the cost-benefit analysis.

Summary of Findings

- We found NMVTIS—if fully implemented in all 50 states and the District of Columbia—can achieve billions of dollars of benefits.
- We calculated the present value of net benefits, under various scenarios, to range from $0.6 billion to $9.5 billion.
- We found the original cost estimates for implementing NMVTIS to be reasonable.

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We present a summary of our findings at this point, to allow the reader to have this information initially.

•We found that NMVTIS—if it is fully implemented in all 50 states and the District of Columbia, and if it is 100 percent effective—can achieve benefits in the range of $4 billion to $11.3 billion annually.

•Because there are many obstacles to full national implementation, we evaluated the costs and benefits of NMVTIS over a range of scenarios. In all of the scenarios investigated, we found the net benefits of NMVTIS to be substantial. After accounting for costs and benefits during 2001–2006, we calculated the present value of the net benefits to range from $0.6 billion to $9.5 billion (in year 2000 dollars).

•We found the original cost estimates to implement NMVTIS in the states and to establish a central management and coordination function at American Association of Motor Vehicle Administrators (AAMVA) are reasonable.

Details of the findings and the analysis behind them are in the following sections.

Outline

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The outline of our report is as follows:

- First, we discuss some relevant **background** information.
- We then provide an overview of our analytical **approach.**
- We provide the details regarding our **cost-benefit analysis** (CBA) methodology and the results. First we discuss how we developed the analytical scenarios, then our cost estimation work, next we describe our benefits quantification effort, and finally we combine the two aspects for some overall results.
- We conducted **sensitivity analyses** to identify parameters that might have a high degree of influence on the results, and to establish upper and lower limits on the potential outcome of the project.
- Finally, we summarize our **findings.**

Outline

- Background
- Approach overview
- Cost-benefit analysis (CBA)–methods and results
  - Scenarios
  - Cost estimation
  - Benefits quantification
  - CBA results
- Sensitivity analysis
- Findings

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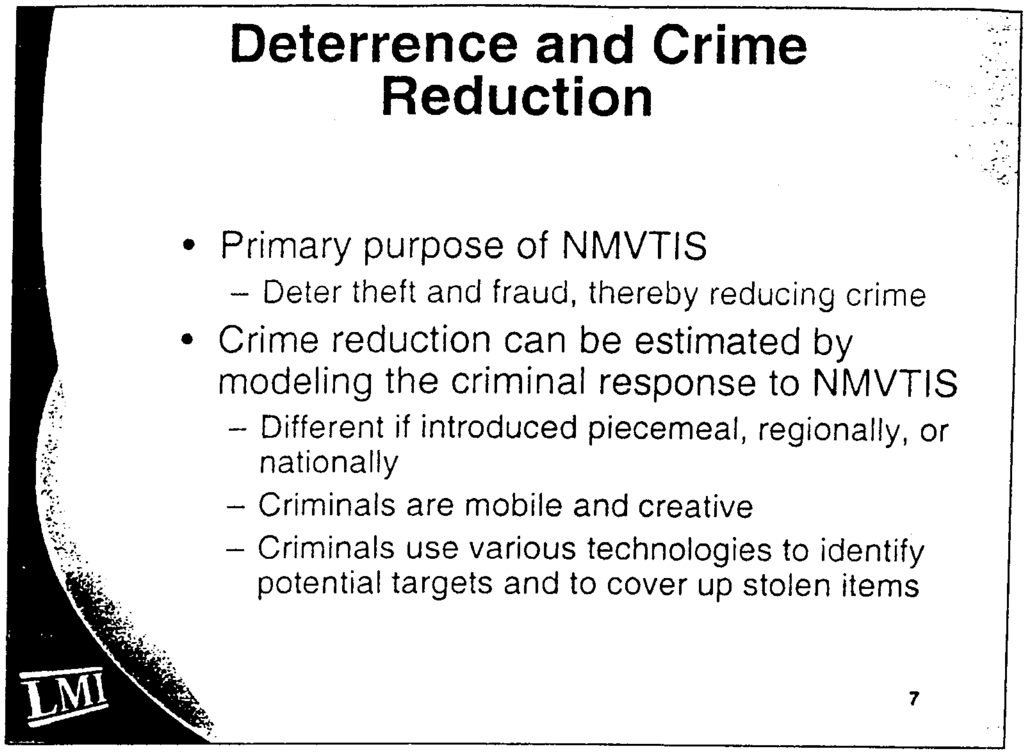
This section covers NMVTIS background information. In this section, we present data and information that we used in the initial phases of our analysis. We used these data—such as crime trends, state theft data, as well as the criminal behavior information—to help us develop analysis scenarios and to substantiate that it was reasonable to translate data from the pilot states to the nation as a whole.



The primary purpose of NMVTIS is to deter theft and fraud, and subsequently to reduce crime.

The way NMVTIS is implemented – piecemeal, regionally, or nationally – will affect how criminals respond. Criminals are highly mobile and may avoid NMVTIS states until most of the country is covered by the system. Criminals use technology to their advantage, both to identify potential theft targets and to camouflage stolen vehicles.

Criminal Response

- Steps in quantifying and monetizing benefits:
  - ***Forecast criminal response***
  - Translate criminal response into changes in auto thefts, odometer rollbacks, title washing
  - Monetize changes in thefts, rollbacks, washed titles by stakeholder
- Major elements in developing forecast
  - Identify emerging crime trends
  - Forecast criminal response for each scenario

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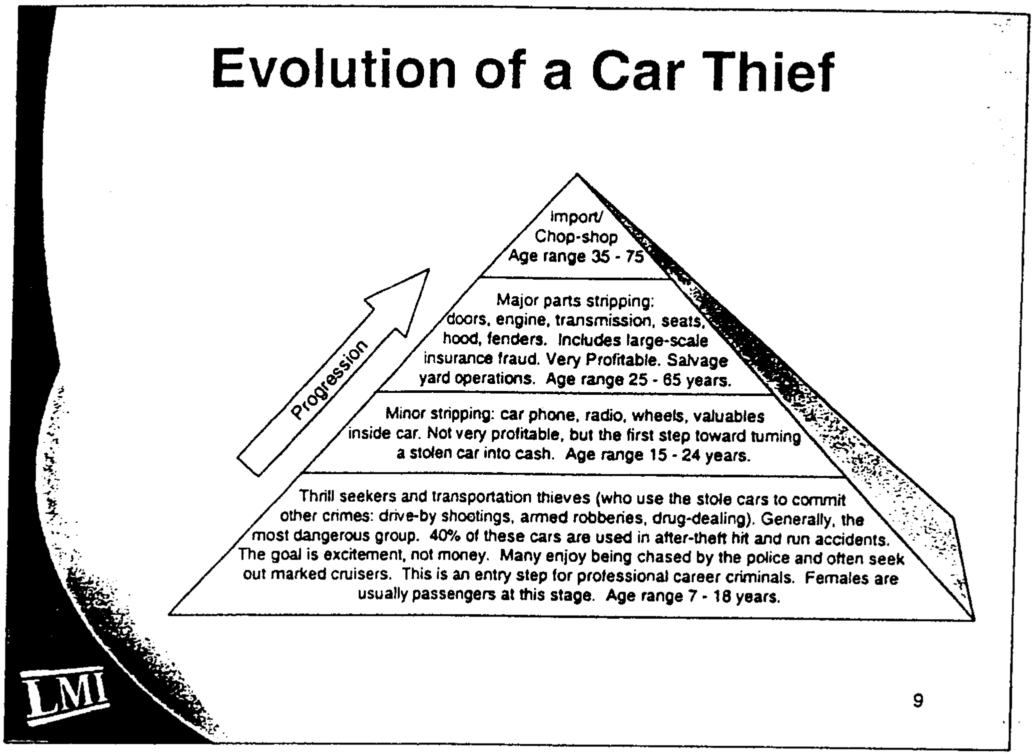
This chart describes how we modeled criminal response and translated those effects into quantified benefits. The perceived criminal response to NMVTIS is key to understanding how it might affect the scenarios we developed and in quantifying crime-related benefits.



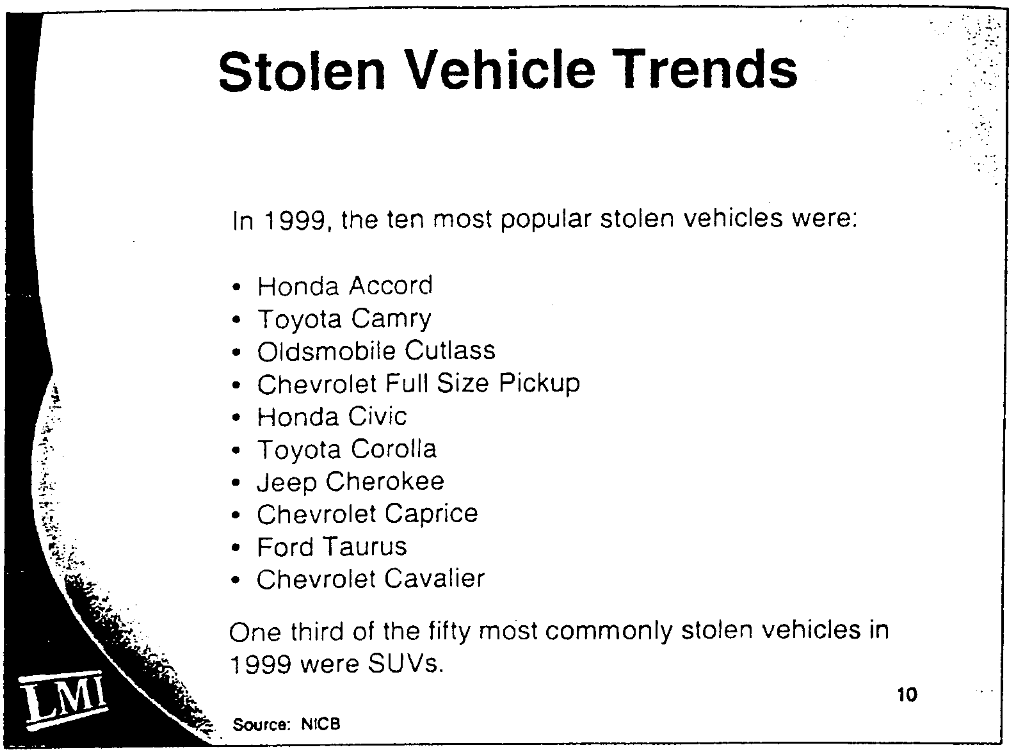
Understanding the way criminals evolve and operate was necessary for us to consider in the process of modeling criminal behavior.

The entry level position for a car thief can best be termed as a "joy rider." This term applies to the most simplistic car thief, who will steal an automobile for a means of transportation from point A to point B. The thief, needing a return ride from point A, will dump off the first stolen vehicle and steal another car for the return ride. This is the person, usually a juvenile between the ages of 7 to 18, who steals a vehicle for a means of transportation. They will take advantage of vehicles left running and unattended at convenience stores or housing complexes.

The second level of vehicle thief is the commercial auto thief. This is the person usually aged 15 to 24 who can work alone or in conjunction with others and are either tightly or loosely organized. A stolen vehicle will mean money to this level and is the beginning of the business.

Next is the major stripping level and people in this category may range in age from 25 to 65. The intent of people at this level is to make a profit from theft, insurance fraud, salvage yard operations, and stripping of vehicles. The stripping is done when the vehicle is parted-out and the pieces are sold. More money can be made by selling the parts than if the entire intact vehicle was sold. The thief can also sell the entire vehicle by switching the vehicle identification number (VIN) and getting a new title issued.

The upper tier of the auto theft business belongs to organized groups that deal in import/export and chop shops. People in these groups range in age from 35 to 75 and tend to be based along ethnic and regional lines. Most of the thefts are for order, where a particular type of vehicle is needed and the group hires a thief who will venture out into the community until they find the precise type that they need to steal. Often this level of the business will take part with the focus being in the exporting of stolen vehicles.



Perennially, Honda and Toyota have topped the stolen car charts. In 1999 there was little change from the past. The Honda Accord ranked first followed by the Toyota Camry as being the most commonly stolen cars in the US. According to the MSAs that were reported by National Insurance Crime Bureau (NICB), one-third of the top fifty most commonly stolen vehicles in 1999 were sport utility vehicles (SUVs), pickup trucks, and minivans. Some new entries to the top fifty were Chevrolet Caprice, Ford Taurus and the Chevrolet Cavalier. For 1999 the ten most stolen vehicles in the US are shown in the chart.

An emerging trend by thieves is a new focus on the ever growing number of SUVs, minivans, and pickup trucks that are found on the roads. As their popularity arithmetically progresses, the revenue for the thief geometrically rises. At the same time it provides camouflage for the thief, who is more apt to blend into the crowded roadways in these vehicles, making it more difficult for law enforcement to find them among the growing number of similar vehicles.

Why has this recently changed? Where will it head? With the advent of the boom of top-end vehicles being legitimately purchased a new market evolves for the thieves. The higher priced vehicles bring more revenue as they rocket up the stolen list. Vehicle thieves are in a business and like any good business, follow market trends. The growth in pickup, minivan, and SUV popularity enable the thief to have more selection and it provides a greater market for the thieves who deal in stolen parts.

What gets stolen and where it gets stolen from is influenced by regional differences and trends. The types of vehicles that are popular vary from city to city and thus what gets stolen varies as well.

In New York in 1999 the top five stolen vehicles were Toyota Camry, Honda Accord, Nissan Maxima, Honda Civic, and Toyota Corolla. The Lincoln Town Car placed seventh which is indicative of its popularity in the region. In Los Angeles the top five were slightly different with the Honda Accord followed by Toyota Camry, Honda Civic, Toyota Pickup, and the Toyota Corolla. The Chevrolet Full Size Pickup was tenth, a regional favorite. In Phoenix, four of the top ten stolen vehicles were pickups; whereas, Washington DC had more minivans and jeeps in its top ten.

Stolen Vehicle Locations

Almost 40% of the stolen vehicles were taken from areas near ports or border states. NICB reported that approximately 450,000 were stolen nationally and 200,000 were illegally exported. The top ten port/border states for auto theft in 1999 were:

- New York (39,693)
- Chicago (31,693)
- Los Angeles (24,677)
- Houston (19,445)
- Phoenix (17,959)
- Dallas (17,854)
- Philadelphia (17,711)
- San Diego (9,491)
- Seattle (8,640)
- St. Louis (6,645)

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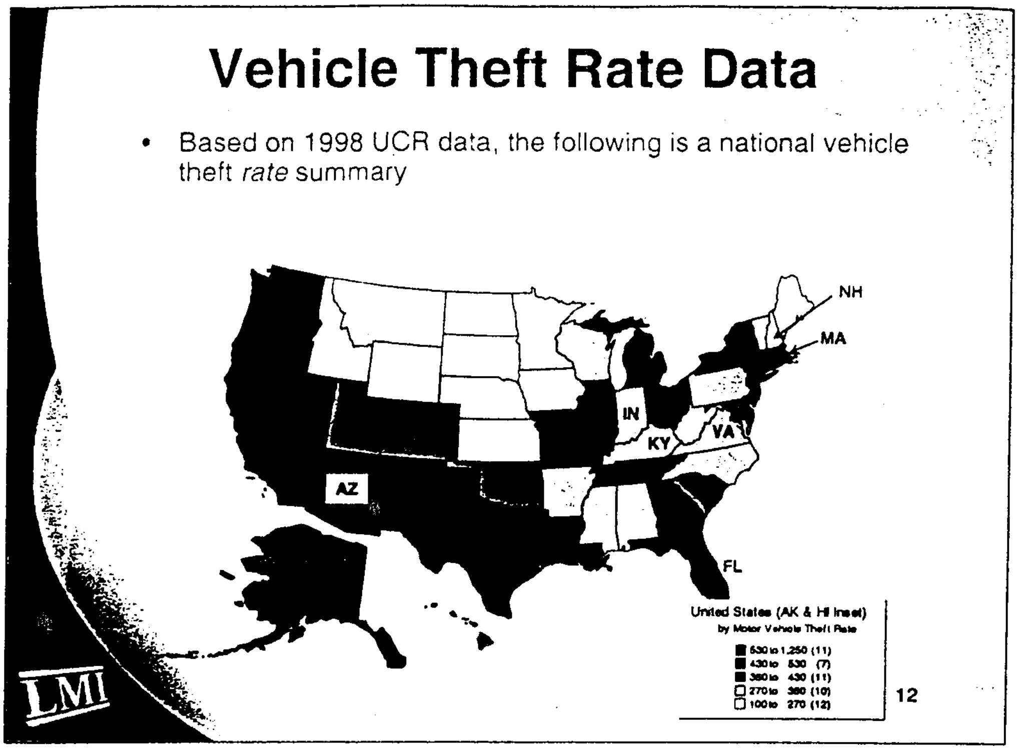
Of all the vehicles stolen the United States annually, nearly 40 percent are taken from the areas near ports or border states. NICB reported that approximately 450,000 vehicles that were stolen nationally and 200,000 of those were illegally exported by thieves. In 1999 New York was the leading port city with Chicago making a giant leap to the second position. The top ten port/border cities for auto theft in 1999 are shown in the chart.

By comparison to 1998, where Los Angles ranked first, New York second, followed by Philadelphia, Phoenix, Houston, Miami, Riverside/San Bernardino, San Diego, Seattle and Oakland the figures had dropped to coincide with the national trend. However, the cost remained constant as the top end higher dollar vehicles became more popular to steal.



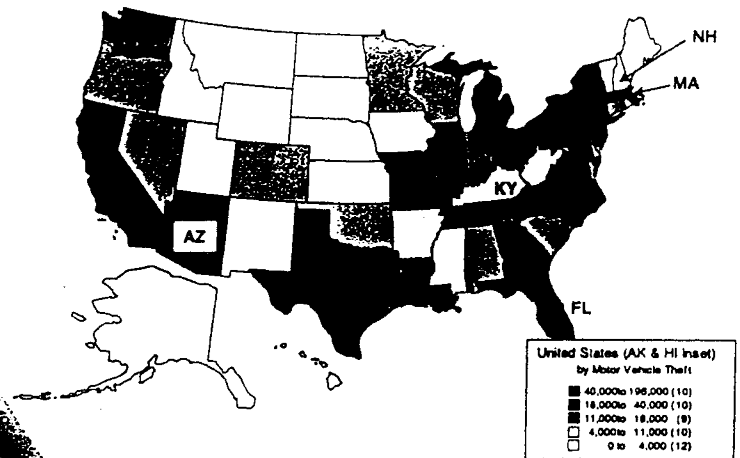
We investigated whether or not crime in the NMVTIS pilot states was representative of crime in the nation overall. If so, it would be reasonable to extrapolate some of the experience and findings to other states in the nation.

The map depicts theft *rates* across the nation – the number of thefts per 100,000 population for each state – using the FBI's 1998 Uniform Crime Reports (UCR) data. Darker colored states have higher theft rates.

The seven NMVTIS pilot states are labeled. One can observe that the NMVTIS pilot states span the spectrum of theft rate categories.

Vehicle Theft Data

- Based on 1998 UCR data, the following is a summary of national vehicle thefts



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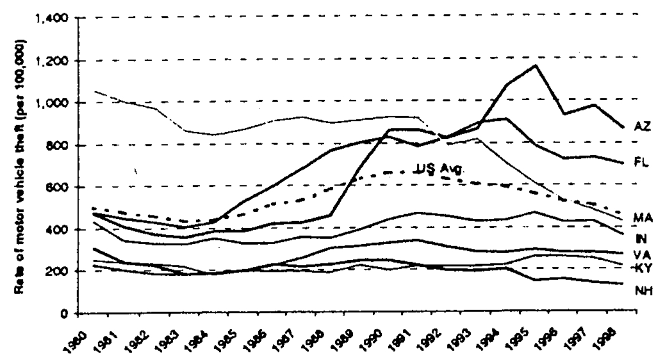
The map depicts the *number* of automobile thefts for each state. Again, we used 1998 UCR data to develop the map. Darker colored states have a greater number of thefts.

The NMVTIS states have been labeled. We can see that the NMVTIS pilot states represent a varying sample of annual thefts.

Historical Theft Data
Seven Pilot States

- Motor vehicle theft rates in the pilot states — represents a broad sample



Source: FBI's Uniform Crime Reports

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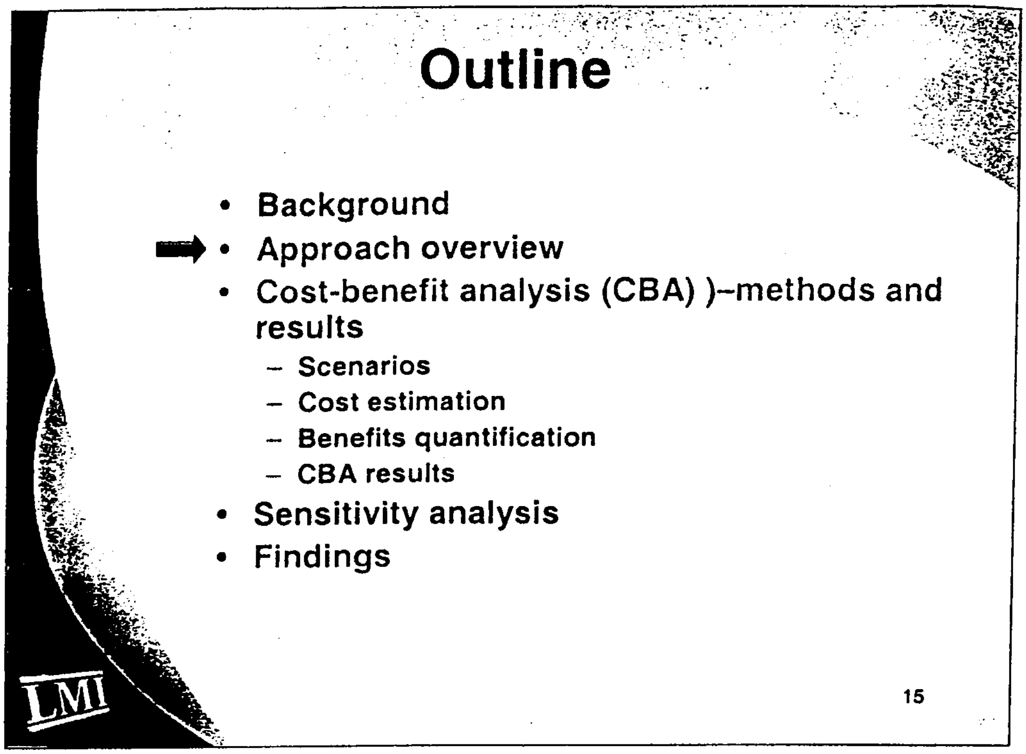
For the seven NMVTIS pilot states, we charted historical theft rates and observed that the pilot states had quite a bit of variability. The chart illustrates the theft rates in the seven pilot NMVTIS states since 1980 and compares those rates to the national average.

The seven pilot states provide a cross section of activity above and below the average theft rate across the U.S.

We also note that AZ, FL, and MA have had substantial fluctuations in their theft rates over the years, while the theft rates in the other four states have remained relatively constant.

From this analysis, we inferred that the pilot states were representative of national trends, and theft reductions that NMVTIS might affect in the pilot states could be generalized to the nation, and to scenarios that included more than the pilot states, but less than full implementation.



In this section, we provide a general overview of our analytical approach.

As we discuss following sections (i.e., scenarios, cost estimation, benefits quantification, and CBA results), we will address details of our approach used in each of those sections.

Approach Overview

- Establish several implementation scenarios
- Collect relevant data
- For each scenario
  - Estimate NMVTIS costs
  - Quantify benefits
  - Conduct CBA, to include sensitivity analysis

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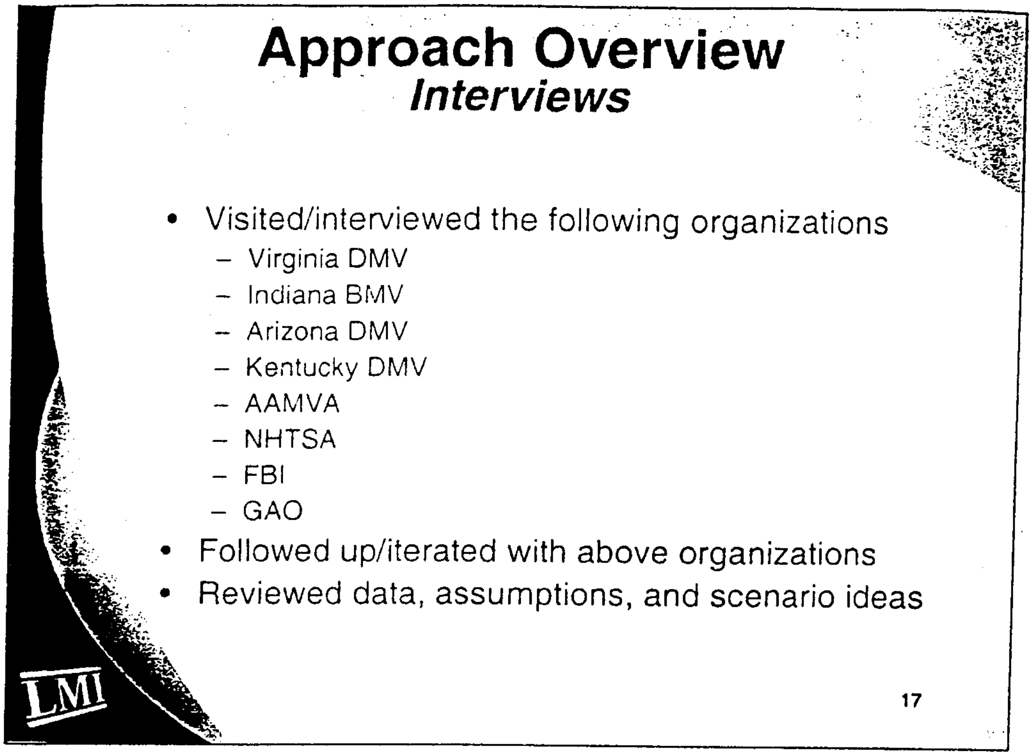
First, we developed several implementation scenarios (described on the next page). We modeled the effect NMVTIS might have on criminal behavior, in each of several scenarios, described later in this report. We then had to forecast how the thefts and rollbacks might occur in the future.

We then collected several types of data. We analyzed demographic data (e.g., populations, vehicle registrations), system performance information (such as staff required to operate it, efficiencies it creates), cost information for NMVTIS from some of the pilot states, and crime data, such as theft rates and odometer rollbacks.

We then estimated NMVTIS costs, using several techniques, and compared those costs to the expenditures to date and to budget figures. Specific cost estimating techniques and results are discussed later.

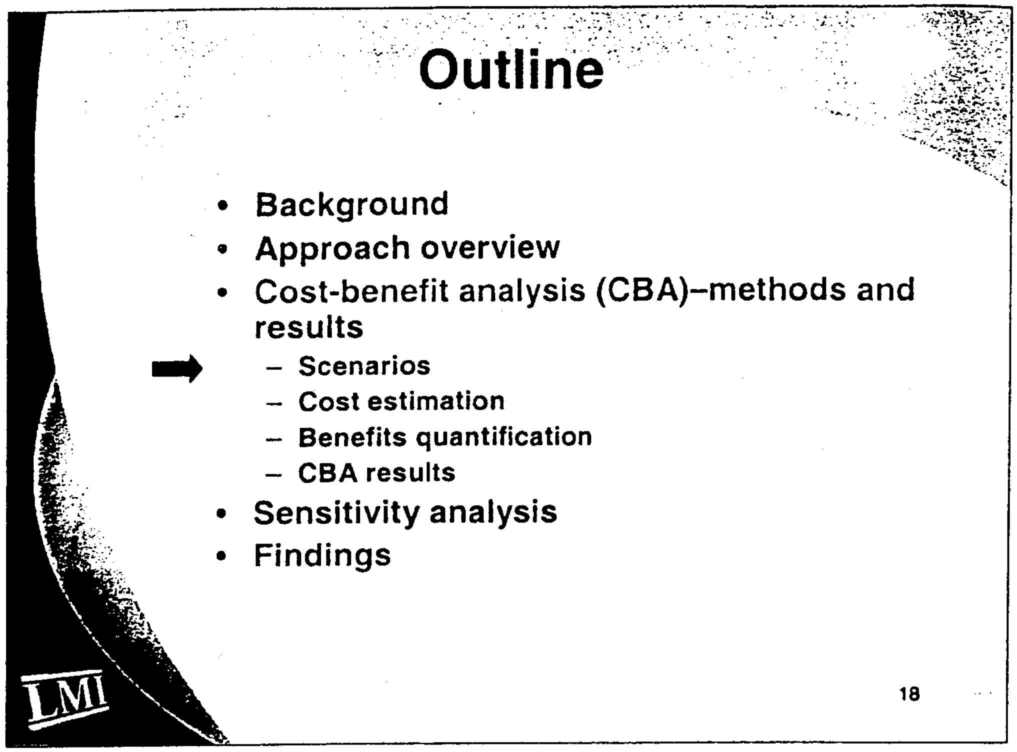
We then quantified benefits by monetizing the effects NMVTIS could have on outcomes such as theft deterrence, vehicle safety, and consumer value.

Finally, we conducted cost-benefit analyses (CBAs) to calculate costs and benefits over several years, and to conduct relevant financial analyses. We also conducted sensitivity analyses to understand the effect that changing parameters and assumptions had on the outcome.

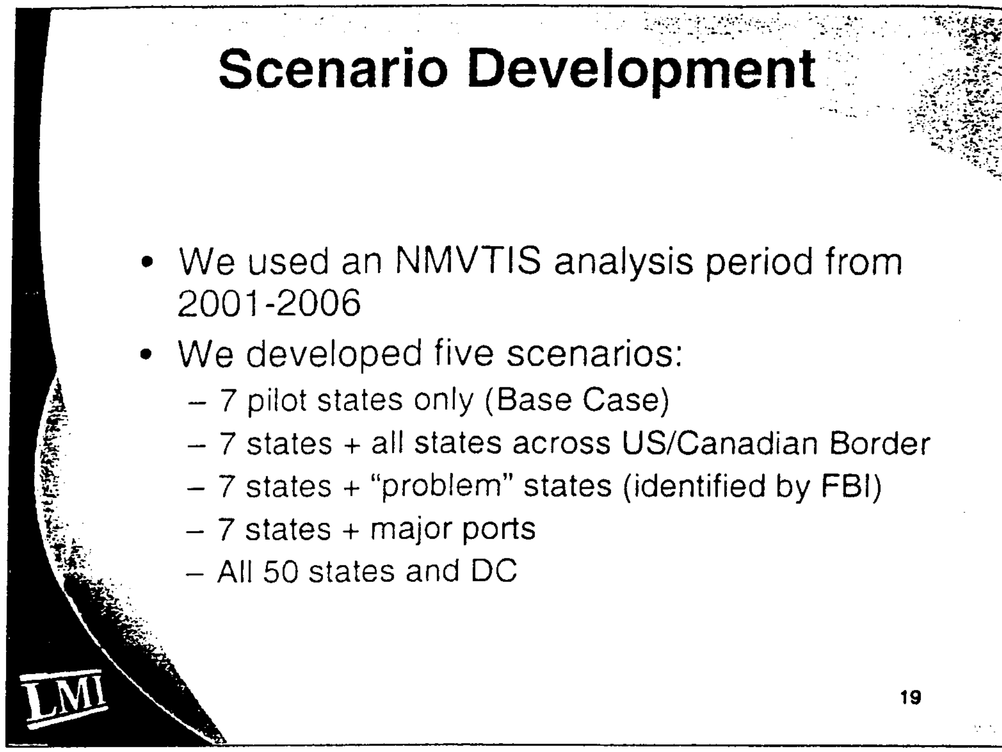


As part of our approach, we visited and/or conducted telephone interviews with the departments of motor vehicles (DMVs) listed above. Also, we met with AAMVA, the National Highway Traffic Safety Administration (NHTSA), the Federal Bureau of Investigation (FBI), and GAO. Those organizations provided us with background information, data, perspectives on operational aspects of NMVTIS, and view points on many of our assumptions and the scenarios we were developing.

After developing some methodologies, assumptions, and scenarios, we often checked our ideas with some of those organizations before continuing on with the analytical process.



In this section, we provide details regarding our cost-benefit analysis (CBA) methodology and the results. First, we discuss how we developed the analytical scenarios.



We assumed it would take five years to implement NMVTIS completely. Also, we assumed that the benefits resulting from implementing NMVTIS would not accrue until the year following implementation, we determined that the analysis period from NMVTIS would be 2001 through 2006.

We developed five scenarios:

1.The first scenario was the base case – assuming only the seven pilot states would have NMVTIS in operation. All other scenarios can be compared to this scenario to determine differences from the status quo.

2. We retain the seven pilot states, but then add states along the U.S./Canadian border, since stolen vehicles tend to "flow south." (e.g., vehicle stolen in Canada often are sold in the U.S., and vehicles stolen in the U.S. are often sold in Mexico.)

3. Again, in this scenario we retain the seven pilot states but add the top ten "problem states" (as identified by the FBI).

4. To the seven pilot states we add states with major ports or border crossings, which also have a high degree of automobile theft (as identified by NICB).

5. The final scenario consists of all 50 states and the District of Columbia. We actually developed two versions of this scenario, which will be discussed later in this section.

Outline

- Background
- Approach overview
- Cost-benefit analysis (CBA)–methods and results
  - Scenarios
  - Cost estimation
  - Benefits quantification
  - CBA results
- Sensitivity analysis
- Findings

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In this section of the cost-benefit analysis (CBA) discussion, we describe our cost estimation methods and results.

Cost Estimation

- Data gathering
  - Data types
  - Data sources
- Methodologies
  - Audit
  - Estimation techniques
- Results

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In the next several pages, we discuss our data gathering efforts for the cost estimation task. We summarize the types of data we used and the sources of that data.

We will discuss our cost estimation methodologies and present our results.

In undertaking the cost analysis, LMI first identified the assumptions upon which the funding request was derived; developed an independent costing methodology; and applied this methodology against the set of assumptions to obtain separate implementation costs for AAMVA and the states that could be compared and reconciled with the initial estimates.

LMI conducted the cost analysis with three goals in mind:

1. Evaluate the initial estimates by providing an independent estimate of an NMVTIS as defined and scoped in the initial estimates;
2. Expand AAMVA costs to reflect development of added functionality (Prospective Purchaser Inquiries (PPI), Customs/Canada interaction, law enforcement expansion) and five year operational costs; and
3. Provide full life cycle costs for states and AAMVA for use in the cost-benefit analysis.

Cost Estimation
Data Gathering

- Data types and sources

Data	Source
• Pilot state expenditures	AAMVA (limited),VA
• Vehicle title/registration history	State DMVs
• Labor rates	IT industry surveys
• IT infrastructure strength	Center for Digital Government
• Govt labor rates	BLS
• Cost of living data	399 MSA Comparisons- Maze Recruiters
• Population data	US Census Bureau

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The table summarizes the data we used for the cost reconciliation task and the sources of the data.

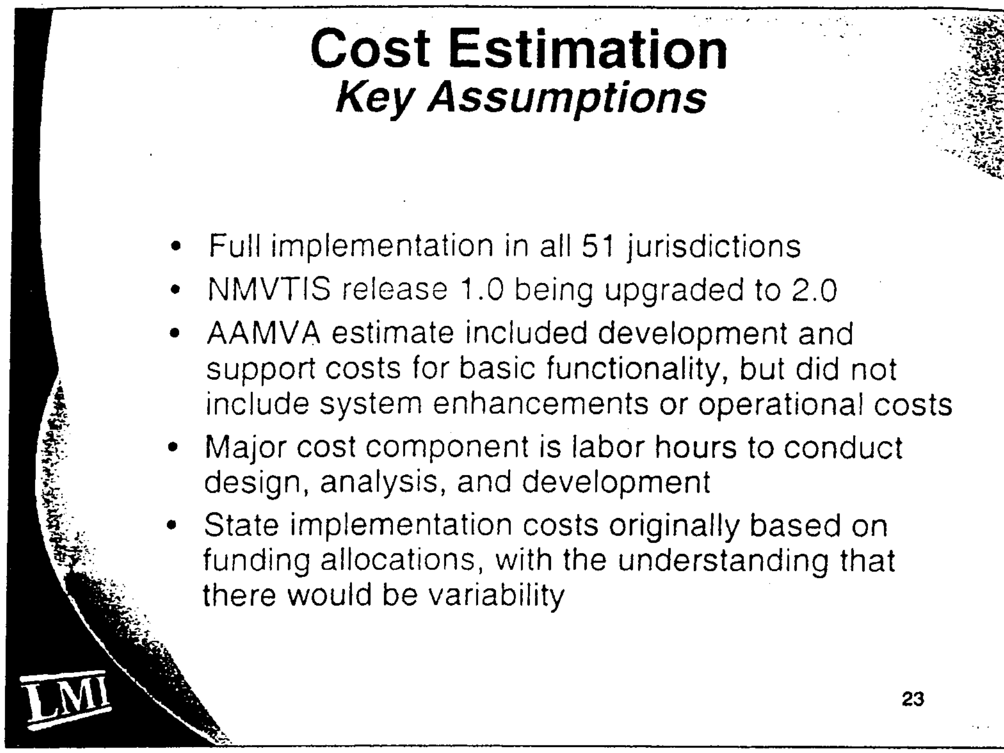
Additionally, the following documents provided over arching background and cost information:

- General Accounting Office, GAO/GGD-99-132, *Anti-Car Theft Act: Is-sues Concerning Additional Federal funding of Vehicle Title System*, Au-gust 1999. We also conducted discussions with authors of the report.
- AAMVA, *National Motor Vehicle Title Information System (NMVTIS): Pilot Evaluation Report*, 15 May 2000. We also conducted discussions with AAMVA analysts and management.

The initial NMVTIS cost estimate of $33.9 million was developed by AAMVA, based on the following breakdown:

- $24.2 million for states to develop new systems or adapt existing ones to link with NMVTIS, and
- $9.7 million for AAMVA and its contractors to develop, test, and implement NMVTIS.

The federal government was expected to fund $22.2 million, which was to be used to offset $16.5 million of the states' cost and to reimburse AAMVA $5.7 million for system development, pilot program management and evaluation, and other technical assistance. The states and AAMVA were expected to cover their remaining costs of $7.7 and $4.0 million, respectively. The GAO and AAMVA cost estimates, as reported in the documents cited above, are identical, simply being a restatement of the existing funding request.



The key assumptions include the following:

• The cost estimate is based on full implementation of NMVTIS for all 51 jurisdictions.

• The system installed at the pilot states is release 1.0, which is currently being upgraded to release 2.0; this is the version that would be installed at future state sites. Release 2.0 incorporates the necessary modifications for shifting responsibility for the VIN pointer and the brand files, and the Manufacturer's Certificate of Origin (MCO) system from Pilot contractors, Polk Company and NICB, to AAMVA.

• The initial AAMVA cost estimates include development and support costs for the basic NMVTIS functionality and linkages to the states, but do not include development costs for system enhancements such as PPI, U.S. Customs/Canada interaction, or extending law enforcement functionality. Finally, the initial estimates do not include any operational costs for either the states or AAMVA.

• The major component of cost is the labor hours required for the AAMVA and state staff to conduct systems analysis, design, and development. Costs for travel and equipment in the initial estimate were negligible.

• State implementation costs were initially estimated on a funding allocation of $300,000 per state, although it was recognized that differences in state staff availability, titling system complexity, or cost of living would create cost variations among states.

Cost Estimation
Methodologies

- Our intention was to develop a reasonable estimate of implementation and operating costs for the pilot states
- We used four econometric and statistical methods to estimate and extrapolate costs for the 44 remaining states. The pilot costs were then added to the four method totals.

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The basic methodology used for both the AAMVA and state costs was a bottom-up analysis, based primarily on identifying the required staff and skill categories, duration of effort in staff-hours, and wages for NMVTIS development, implementation, and support. As a means of coping with cost uncertainty, additional estimates were generated for the states using a uniform per state implementation cost and, in another case, derived multi-attribute indices to distinguish individual state cost differences.

LMI developed four separate cost estimates for the states, using baseline and estimating methodologies to derive costs for comparison with the initial state funding or cost estimate of $24.2 million. AAMVA costs are derived for developing and supporting the NMVTIS implementation both as presently planned and configured, and in its enhanced mode. These costs can be compared with the initial estimate of $9.7 million for AAMVA and its contractors.

The initial costing plan was to develop a reasonable estimate of pilot state costs and to extrapolate that experience to other states; but the data were neither consistent nor comprehensive for that purpose. Costs were not reported in sufficient depth, often just covering the dollars up to the authorized funding or grant level, resulting in an indeterminate amount of underreported cost. Moreover, the added cost of being a pilot state (rather than one of the follow-on "production" states) could not be isolated, nor could we identify the costs expended to upgrade current motor vehicle title systems as preparation for NMVTIS implementation. For these reasons, we did not compute any learning curve discount for follow-on state implementations although, intuitively, it could be expected that the per state cost would decrease as more systems are fielded. In fact, we have already observed several instances of potential savings as some states, e.g., Indiana and Virginia are sharing their developed code (as well as their consultants) with neighboring states. Omitting those potential savings lends an upward bias to the cost estimates.

Cost Estimation
Methodology 1

- This methodology built a typical labor profile for completing the implementation life cycle and assigned staff positions, project durations, and salary rates to estimate cost.
  - Varied the project duration +/ - 20 percent around a derived 49 staff months.
  - Six staff positions were modeled
  - Salary rates were extracted from the National Salary Survey by J & D Resources
  - High and low salary rates (loaded) were used to develop a feasible range

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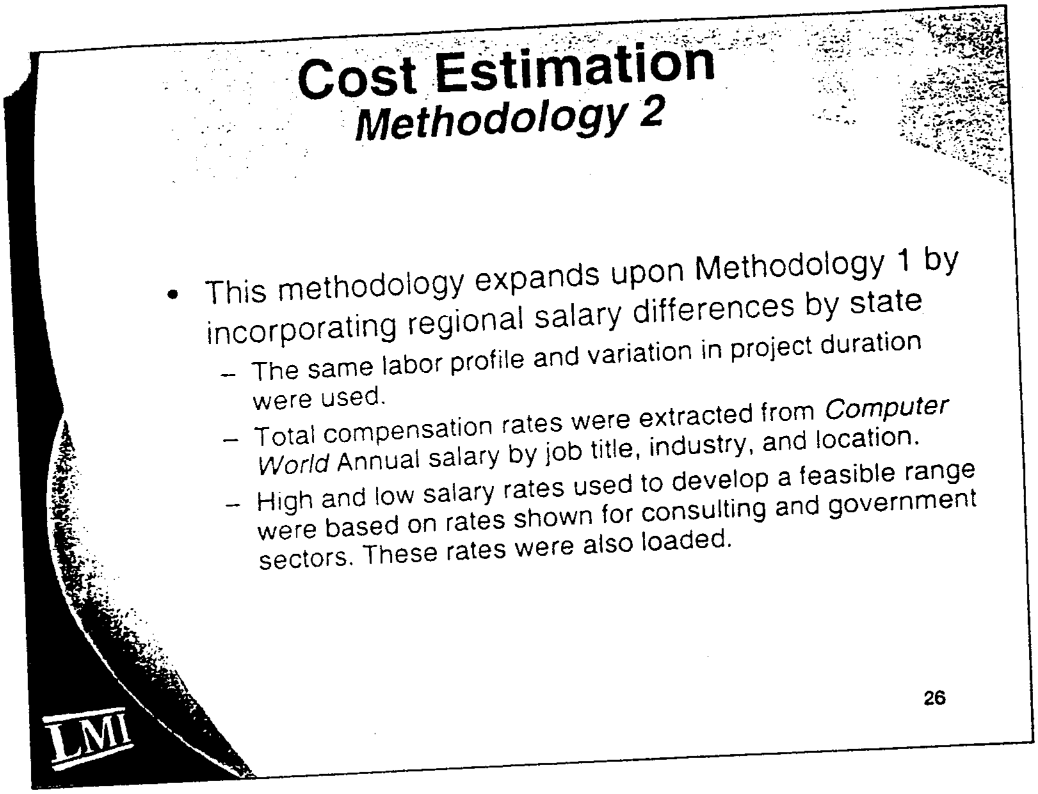
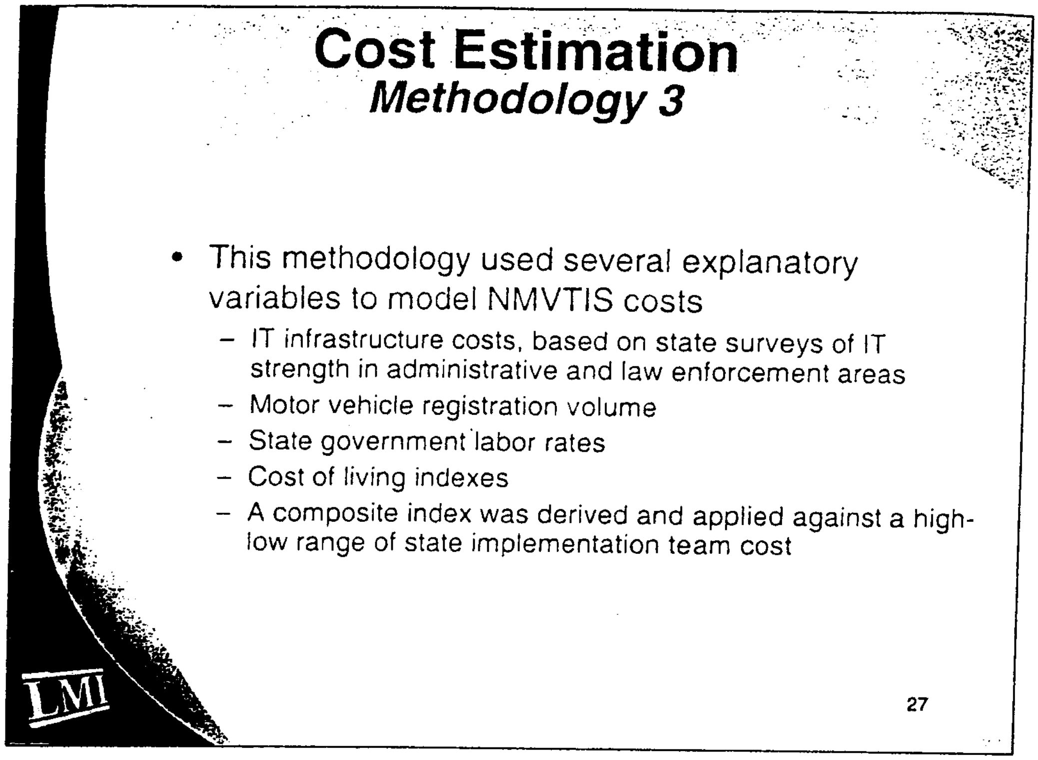
Methodology 1: We built a typical staff profile for implementation using labor categories- project leader, functional and technical analysts, and programmers- expending a total of 39-59 staff months. The profiles and effort were further verified in discussions with AAMVA staff who participated in the NMVTIS pilot deployment. Salaries were extracted from the National Salary Survey by J&D Resources, Inc. and subsequently loaded with overhead rates of 40% or 100% for government and contractor personnel, respectively. Cost ranges were developed based upon low/high effort estimates and whether the implementation team was all government or all contractor.



***Methodology 2*:** For this methodology, we used the same labor profile, government vs. contractor personnel distinction, and range of effort as Methodology 1, but introduces another salary survey, from *Computer World*, magazine that permits state salaries to be differentiated by region (nine regions are identified), rather than using a single national average.



Methodology 3: In this methodology, we used the derived low/high cost range for state implementation from Methodology 1, but applied a composite index against each non-pilot state to adjust those costs to reflect specific conditions existing in that state. The index is a composite of four variables that help to explain likely variation in implementation among states. Those variables include condition of information technology (IT) infrastructure, motor vehicle registrations, state government labor rates, and metropolitan cost of living indices.

Cost Estimation
Methodology 4

- This final methodology simply used the high and low pilot state estimates, assuming other states would fall within that range
  - The lowest estimate (Florida) was multiplied by 44 to calculate the lowest possible cost
  - The highest estimate (Virginia) was multiplied by 44 to calculate the highest possible cost

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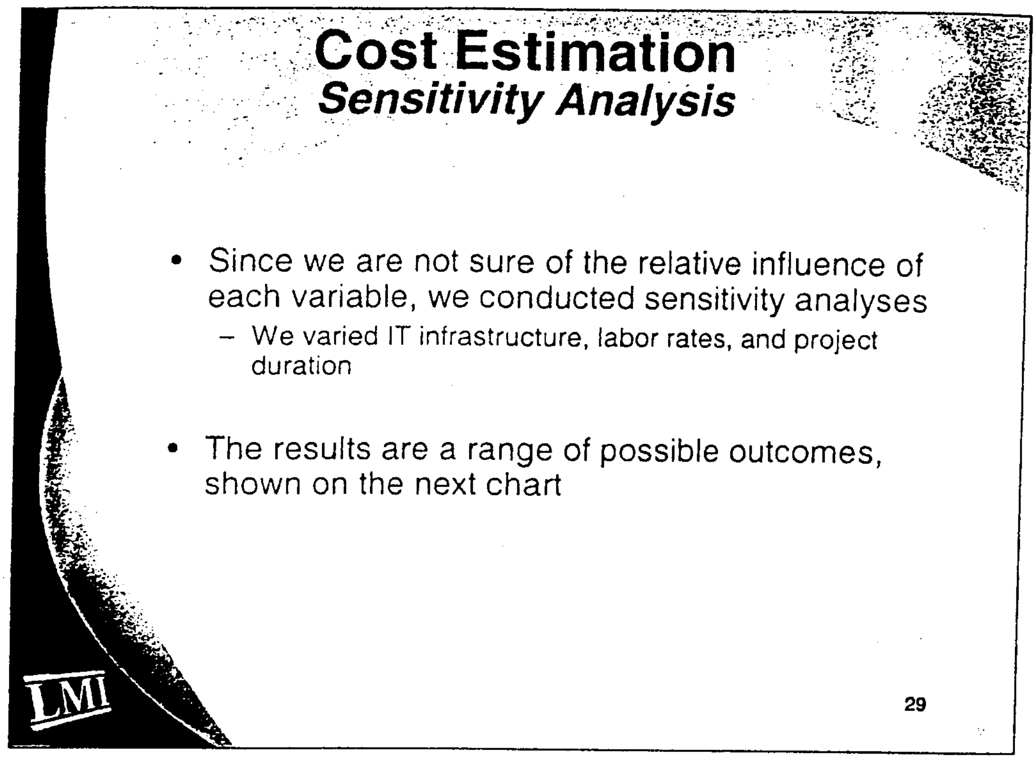
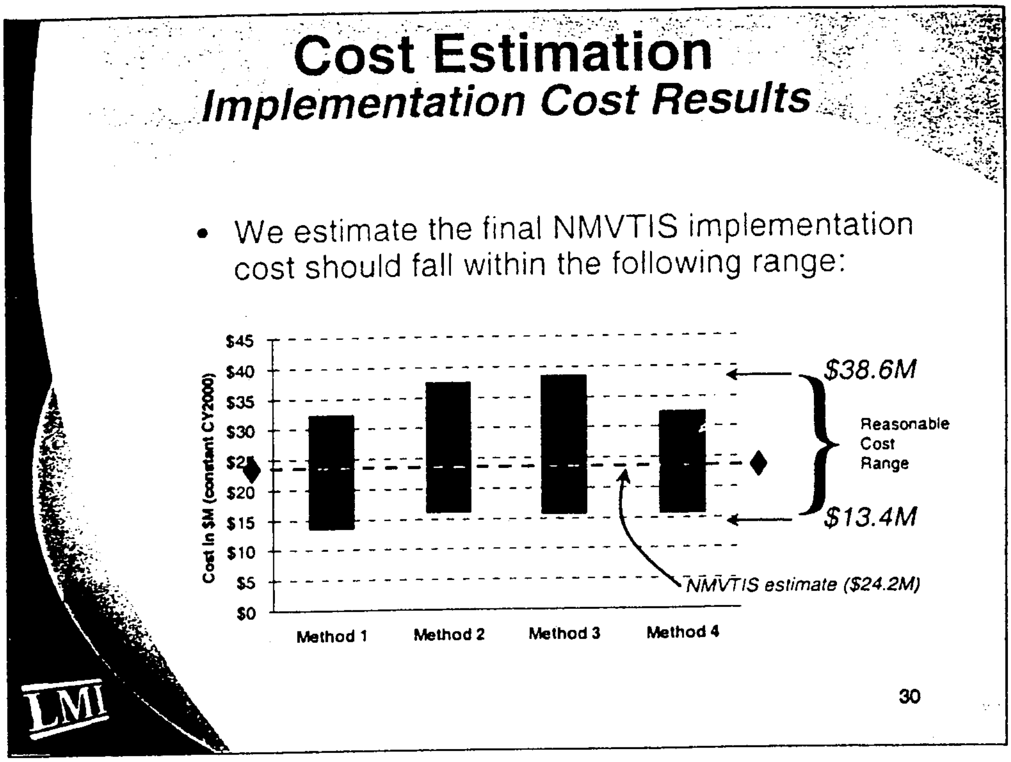
Methodology 4: For this methodology, we simplistically used the high and low pilot state implementation estimates, as reported to AAMVA, and applied them uniformly across all non-pilot states to generate a low and a high cost for total implementation.



There are many uncertainties involved in cost estimating. Also, since we had to develop econometric models using multiple variables, and no model is perfect, we cannot assume any model will provide a result exactly mimicking the cost history. Therefore, we conducted sensitivity analyses of key variables to determine how using the high and low values for each estimate might show overlap among the methodologies, make any of the methodologies outliers, and compare to the original AAMVA cost estimate.



As can be seen in the graph, the initial AAMVA *implementation* cost estimate for the states falls in the middle of the low-high cost ranges derived using the four cost estimating methodologies. It can therefore be concluded that the initial estimate is a reasonable projection of cost for total state implementation of the current, first phase NMVTIS.

We also estimated operating costs to properly conduct the CBA.

Cost Estimation
AAMVA Cost Results

- Costs for AAMVA were derived by identifying activities and processes for NMVTIS implementation, and assigning staff and durations.
  - Activities include: site visits,acceptance tests, help desk,revisions and upgrades, new pilots, and support
  - A preliminary point estimate of $9.1 million with a 20% band of $7.2 - $10.9 million was derived. Current budget estimate in GAO report is $9.7 million.

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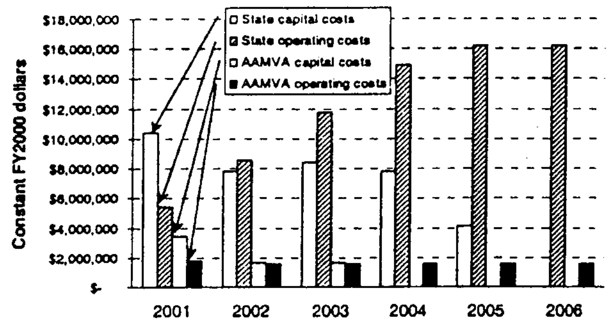
The AAMVA cost estimate was based on full implementation of release 1.0 or release 2.0 of NMVTIS for all 51 jurisdictions, and included the AAMVA assumption of responsibility for the VIN pointer and the brand files, and the MCO system from NMVTIS pilot contractors, Polk Company and NICB. In its role of system developer, AAMVA specifically supports the implementation of NMVTIS through site visits, acceptance testing, help desk operations, revisions, and maintenance of central files. More broadly, AAMVA also serves as an clearinghouse for NMVTIS analytical data and responses to queries from states interested in participation.

The initial $9.7 million cost estimate includes development and support costs for the basic NMVTIS functionality and linkages to the states, but does not include development costs for system enhancements such as PPI, U.S. Customs/Canada interaction, or extending law enforcement functionality. AAMVA's operational costs are specifically excluded as well, since federal reimbursement is limited to development cost. LMI, with the assistance of AAMVA managers and analysts, developed costs for the future enhancements, as well as estimates for AAMVA operational costs.

LMI estimates that the past and projected cost for AAMVA to complete the NMVTIS release 2.0 implementation is $7.6 million, approximately 20 percent below AAMVA's initial estimate of $9.7 million. However, the LMI estimate does not include any cost recovery of AAMVA operational costs for data center operations, meetings, and central file maintenance nor does it include any preliminary design or analysis of enhancements.

Cost Summary (cont'd)

- An example of annual stakeholder costs, for Scenario 5



The total national cost present value is $102M

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This graph shows, for Scenario 5, the annual costs by stakeholder.

This chart displays both implementation (capital) costs, and annual operating costs.

AAMVA costs begin to decrease each year as state costs ramp up. By 2006, all states have NMVTIS implemented and final, steady-state recurring (operating) costs are shown.

Cost Summary (cont'd)

- The following table summarizes the annual costs for each scenario, assuming the high cost ranges were used

	2001	2002	2003	2004	2005	2006
Scenario 1	$ 10.5	$ 5.5	$ 5.5	$ 3.8	$ 3.8	$ 2.2
Scenario 2	$ 13.8	$ 9.9	$ 9.6	$ 6.4	$ 6.4	$ 4.8
Scenario 3	$ 13.8	$ 9.5	$ 10.5	$ 7.7	$ 7.0	$ 5.4
Scenario 4	$ 13.4	$ 9.6	$ 8.4	$ 6.1	$ 6.1	$ 4.5
Scenario 5A	$ 22.9	$ 19.1	$ 21.5	$ 25.2	$ 21.6	$ 16.2
Scenario 5B	$ 20.9	$ 19.7	$ 23.5	$ 24.4	$ 22.0	$ 16.2

Millions of constant 2000 dollars

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This table shows the annual costs for each scenario, based on using the high cost estimates.

Cost Estimation

Summary

- To make up for a lack of data, we used several cost estimating methodologies
- NMVTIS cost estimate for state implementation lies near the mid-points of our estimated ranges
  - Potential exists for considerably higher and lower costs
  - Many factors at work, e.g., code sharing, economic and political issues peculiar to states
- AAMVA cost is within 7% of our estimate

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This chart summarizes our cost reconciliation findings.

Overall, we found the NMVTIS cost estimates to be reasonable.

Outline

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  - Cost estimation
  - Benefits quantification
  - CBA results
- Sensitivity analysis
- Findings

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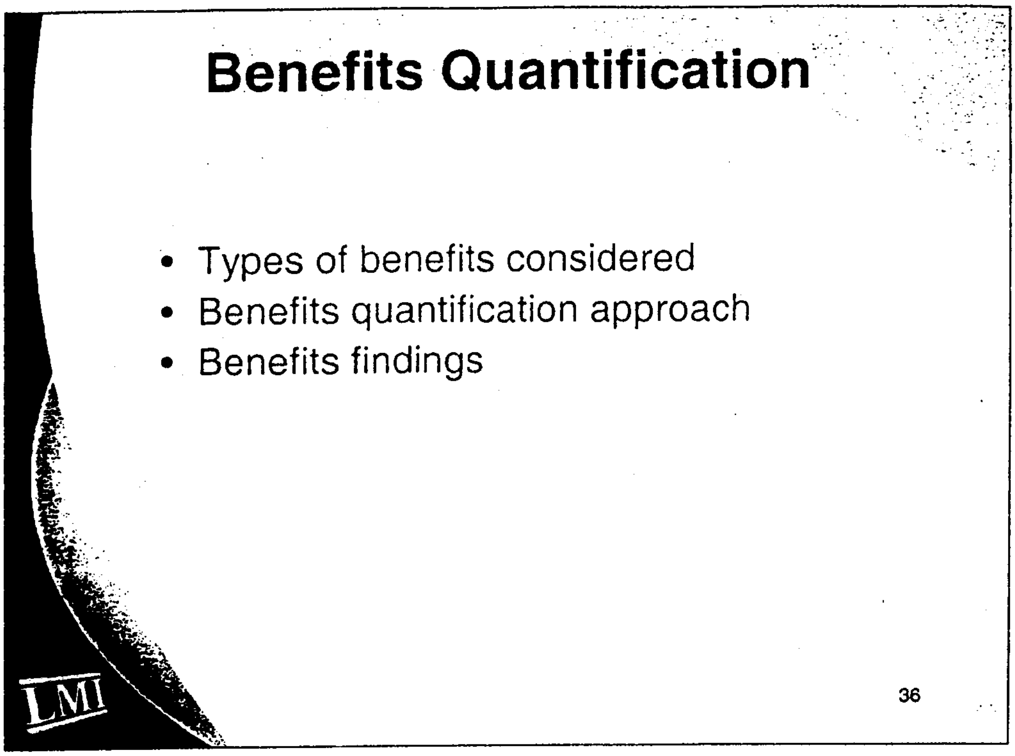
In this portion of the cost-benefit analysis (CBA), we describe our benefits quantification work.



In this section, we discuss the types of benefits we analyzed, our approach to quantifying benefits, and our benefits findings.

Benefits Quantification
Types of Benefits

- Several areas of benefits to be accrued (and primary stakeholder affected)
  - Deterrence and reduction in crime (local jurisdictions and states)
    - Vehicle safety improvements (consumers)
    - Better consumer value (consumers)
  - Cost avoidance (states)
  - System efficiency (states)

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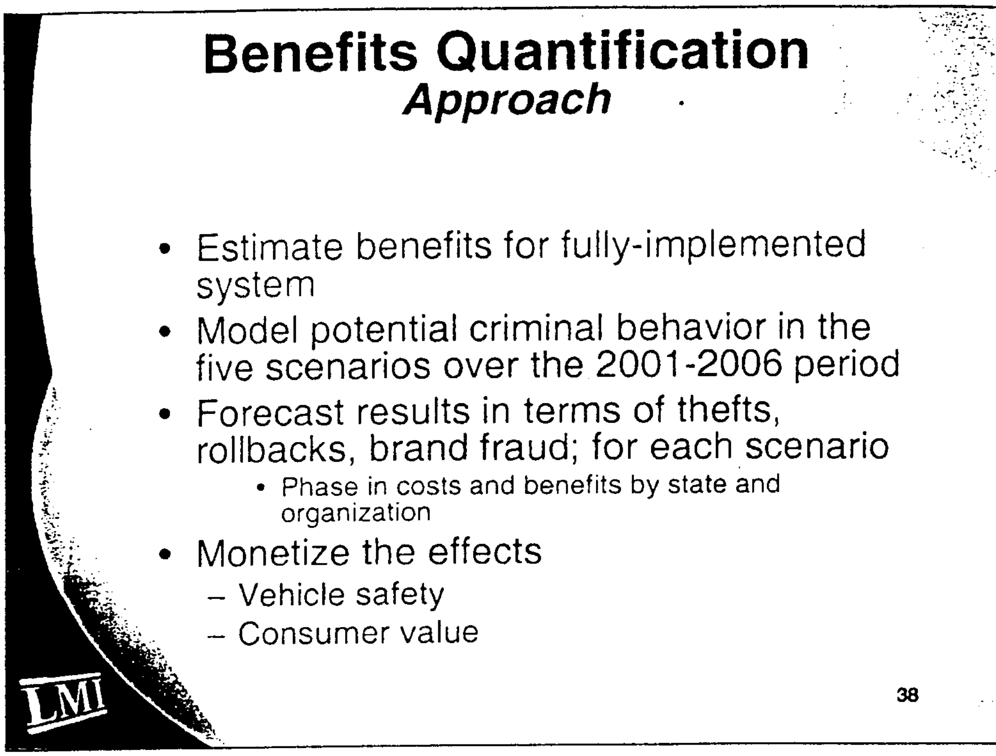
In general, there are several types of benefits that may accrue as a result of NMVTIS implementation.

The primary goal of NMVTIS, according to the Anti-car Theft Act is theft deterrence. That is a benefit area we emphasized. Not only do state and local jurisdictions benefit from theft deterrence, but citizens and consumers benefit as well. Deterring theft provides consumers with safer vehicles (if they know a car isn't stolen or hasn't had the odometer rolled back, they may be more confident in the vehicle and will have a better understanding of the vehicle's history, making future maintenance decisions based on better information). Consumers also receive greater value for their money if they are paying fair market value for a clean vehicle.

Other benefit areas include cost avoidance, if NMVTIS is to replace older, more maintenance intensive equipment or if staff levels can be reduced (or more effectively applied to other areas). Additionally, NMVTIS may improve efficiency at DMVs by reducing paperwork, improving processing times, and reducing errors.

Four stakeholder groups were analyzed:

- Consumers
- State/local government
- Federal government
- Insurance companies

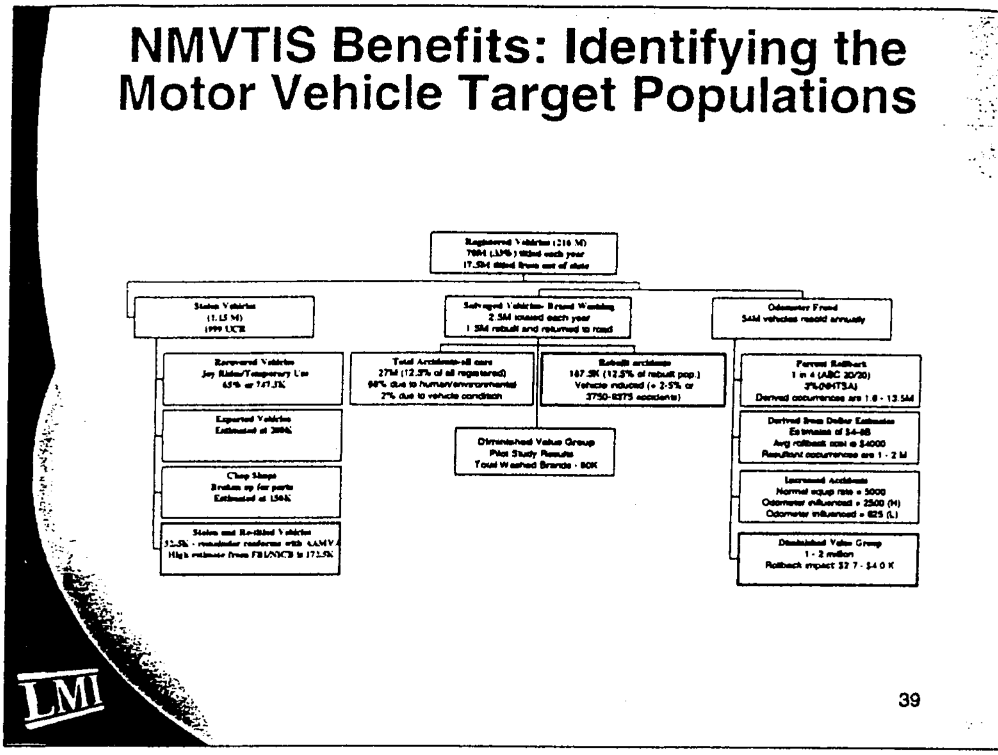


Our approach to quantifying NMVTIS benefits is composed of several steps. First we estimated the benefits NMVTIS would provide if fully-implemented in the 50 states and DC. We assumed NMVTIS would be 100% effective in deterrence and prevention of theft, brand washing, and odometer fraud. This provided the upper boundary – the maximum achievable benefits.

Next we modeled potential criminal behavior for each of the five scenarios, assuming NMVTIS would be 100% effective for each state considered in the scenarios.

Then we scaled down the maximum achievable benefits to more accurately reflect imperfections in the system. We forecast likely results of having NMVTIS available in only a limited number of states. We factored in implementation curves and phased states in over multi-year periods.

We quantified benefits in dollar amounts of outcomes on theft and fraud deterrence, vehicle safety, consumer value, and system efficiencies. We then quantified each benefit for four stakeholder groups: consumers, insurance companies, state and local governments, and the federal government. We researched the size of the overall problem, then identified target populations (i.e., who are the victims that NMVTIS would affect).



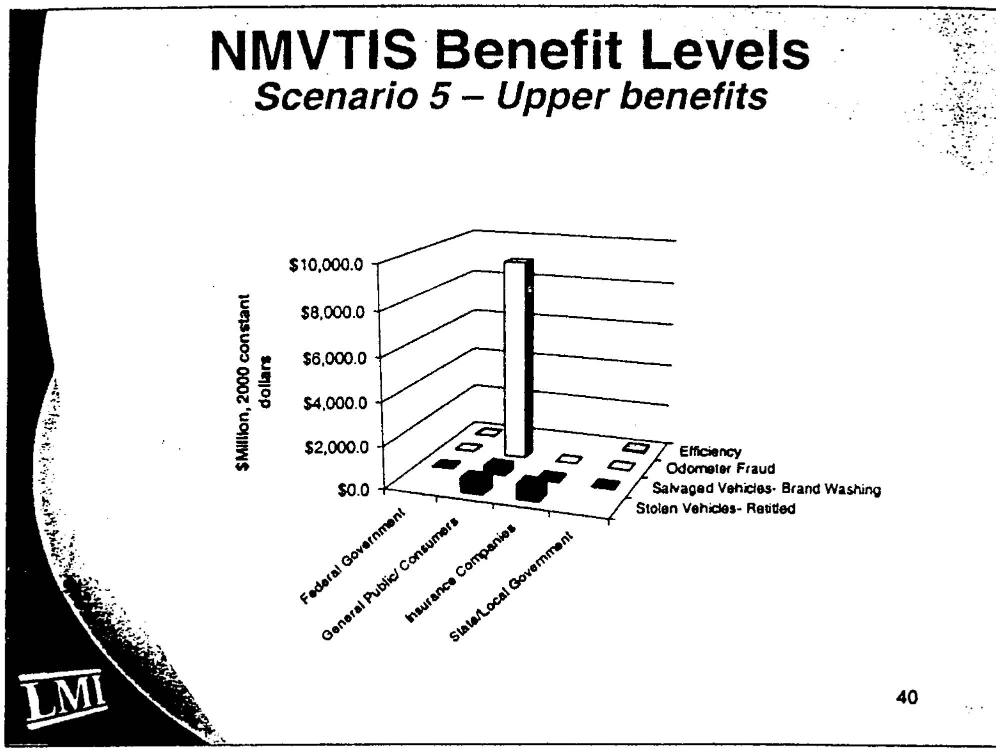
The diagram shows vehicle populations affected by theft, brand washing, and odometer rollbacks. Starting at the top, center of the diagram, we see that the total population of registered vehicles in the U.S. is 216 million. Approximately 70 million (33%) are titled each year. Of those, approximately 17.5 million are out-of-state titlings.

We show three subgroups of vehicles. Starting on the left, the next tier down shows stolen vehicles equaling about 1.15 million. The central subgroup shows the potential for salvaged vehicles involved in brand washing. About 2.5 million vehicles are totaled each year, and of those 1.5 million are rebuilt and returned to the road. The subgroup on the right hand side shows our odometer fraud calculations beginning with a total potential population of 54 million vehicles that are resold annually. The shaded box in each subgroup shows the population considered in our analysis. Now we'll look at each subgroup in some detail.

• **Stolen vehicles**. Within this subgroup, we show recovered vehicles, exported vehicles, chop shops, and stolen and re-titled vehicles. We only considered the effect of reducing stolen & re-titled vehicles (totally approximately 52,500) in our analysis.

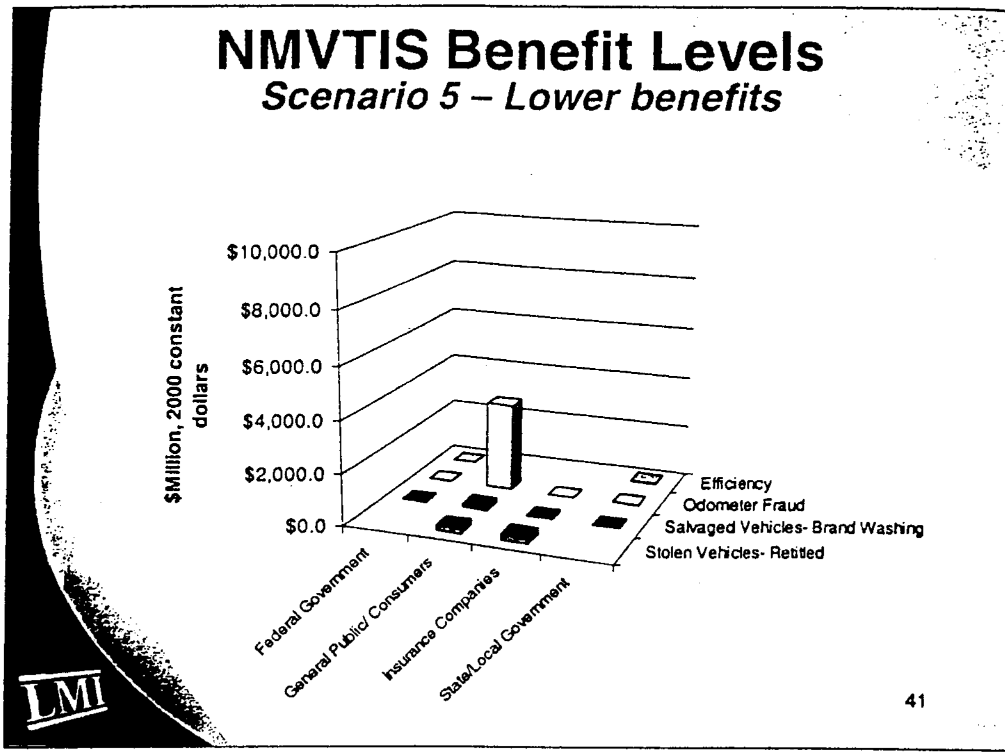
• **Brand washing**. Of the 1.5 million rebuilt vehicles, we used a population of 12.5% of those as a basis. Then, we estimated that between 2-5% of those accidents were vehicle-induced. Therefore, assuming someone did a history check with NMVTIS, they would have seen that the vehicle was rebuilt and might not buy it, or might be more careful with it and there would be fewer vehicle-induced accidents.

• **Odometer fraud**. There were several cited estimates available for this figure. We took the most conservative one – 1-2 million per year and calculated, based on blue book values, the price impact (felt by unknowing consumers) to be from \$2.7K - \$4.0K per incident.



First, we quantified the maximum benefits achievable under Scenario 5 (all 50 states and DC have NMVTIS implemented). Even after using very conservative estimates, one can see that preventing odometer fraud results in $9.3 billion in annual benefits. Adding up all the other benefit areas, we calculate a grand total of $11.3 billion annually.

These values represent what we believe are the extreme upper limit of achievable benefits, assuming NMVTIS is implemented fully and is 100% effective.



For the lower bound of Scenario 5, we estimate annual benefits of approximately $4 billion. We see that odometer fraud still represents the greatest benefit payoff area. Again, this assumes NMVTIS is fully implemented and is 100% effective.

We used these two bounds of Scenario 5 benefits to develop benefit estimates for the other scenarios, which is described in the cost-benefit analysis section.

Benefit Summary (cont'd)

- The following table summarizes the annual benefits for each scenario, assuming the low benefit ranges were used

	2001	2002	2003	2004	2005	2006
Scenario 1	$ 38.9	$ 60.2	$ 89.8	$ 140.8	$ 226.0	$ 360.8
Scenario 2	$ 38.9	$ 79.8	$ 149.4	$ 257.8	$ 413.6	$ 659.9
Scenario 3	$ 38.9	$ 100.6	$ 208.6	$ 545.9	$ 912.3	$ 1,456.5
Scenario 4	$ 38.9	$ 105.4	$ 284.6	$ 469.2	$ 753.5	$ 1,203.3
Scenario 5A	$ 38.9	$ 116.3	$ 295.8	$ 527.8	$ 1,052.3	$ 2,032.0
Scenario 5B	$ 38.9	$ 242.8	$ 448.0	$ 768.2	$ 1,270.2	$ 2,032.0

Millions of constant 2000 dollars

LMI

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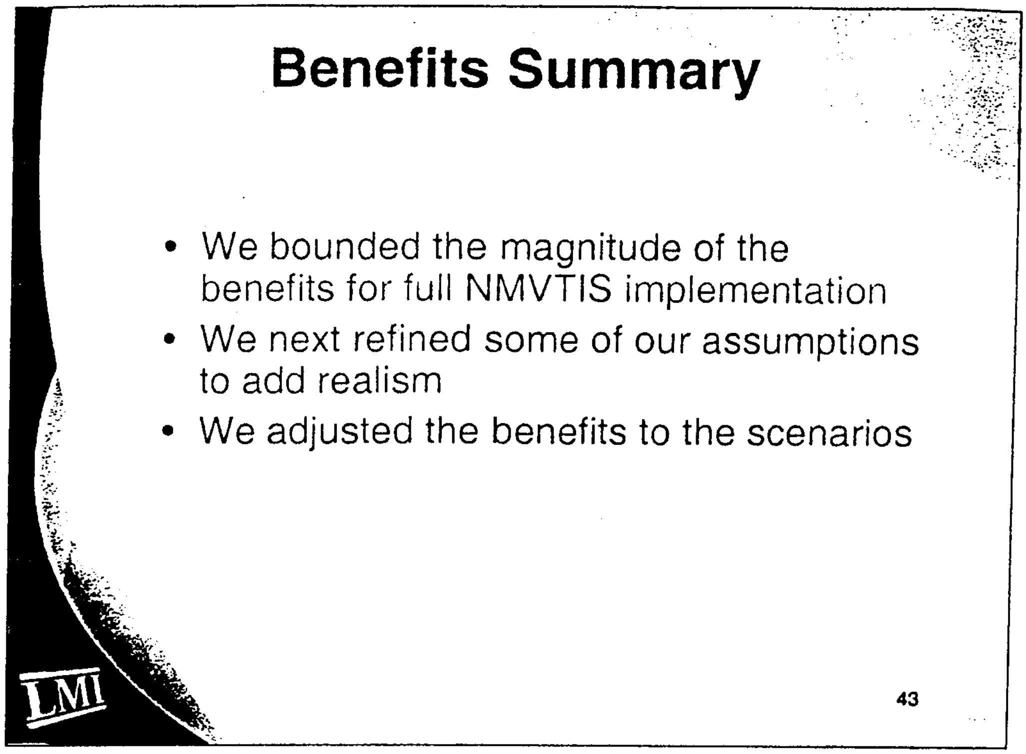
The table summarizes the annual benefits for each scenario. In this example, we used the low-end of the benefit estimates that we developed. The benefits shown in the 2006 column represent the steady-state recurring benefits for each scenario.



To summarize our benefits quantification procedure, we first bounded the magnitude of Scenario 5 benefits, to establish upper limits on the achievable benefits.

We then added realism and phased in benefits over several years, which will become more evident in the next section.

Outline

- Background
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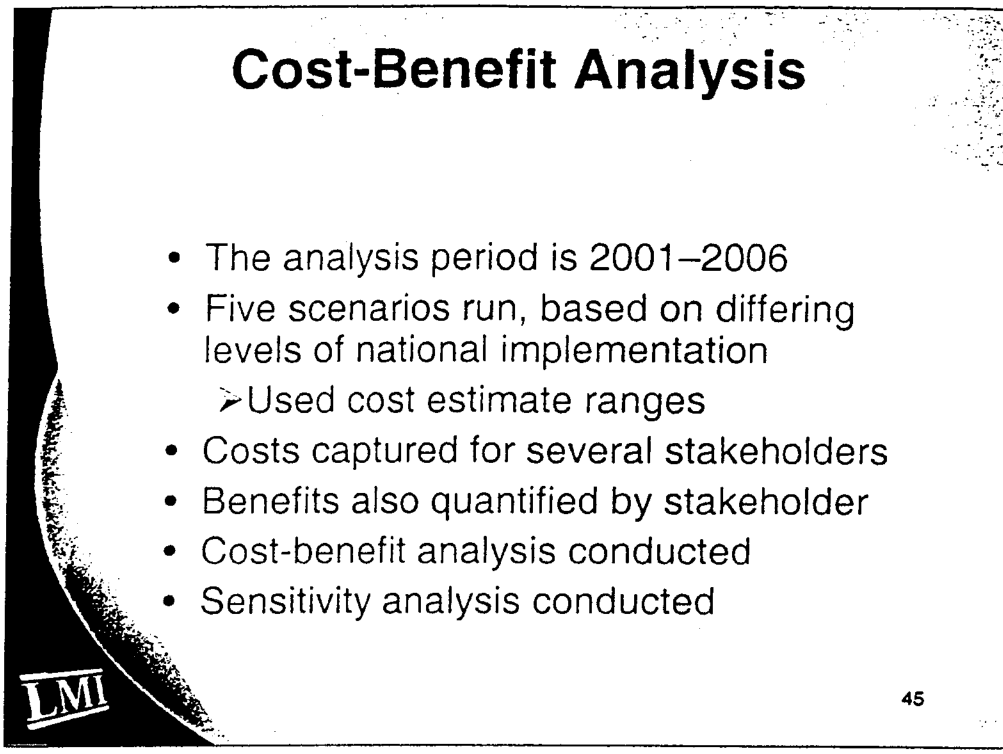
In this final portion of the cost-benefit analysis (CBA) section, we provide the results of analyzing NMVTIS costs and benefits.



In this section we discuss combining the cost estimates and the benefits quantification work into a cost-benefit analysis.

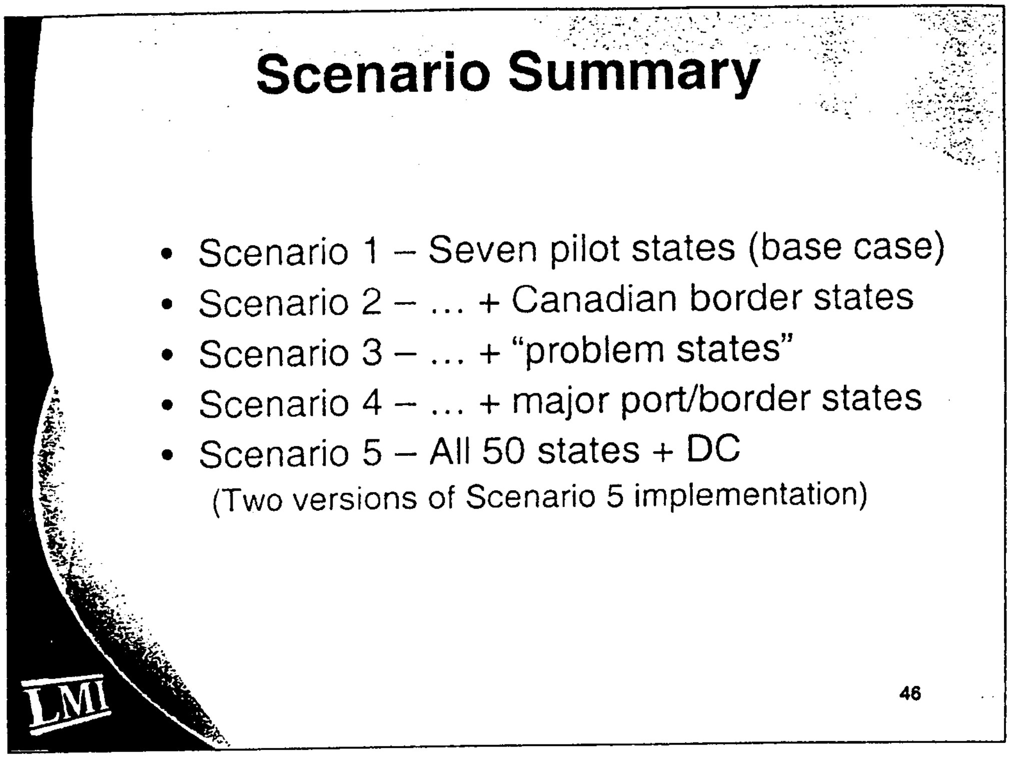
The analysis period considered was 2001-2006 to enable NMVTIS to be phased in over five years and to model benefits accruing the year following implementation.

We conducted the analysis for each of the five scenarios, using upper and lower cost and benefit estimates for each scenario.

Costs and benefits were calculated by stakeholder, by year, in a cash flow format.

We calculated basic cost-benefit analysis financial measures, such as net present value (NPV) and benefit-to-cost ratio.

We conducted sensitivity analyses on key parameters to see if varying our estimates would affect which scenarios "led" and if any positive scenarios became negative.



This chart simply reviews the scenario definitions, since we will discuss them in great detail in this section.

Of note, two versions of Scenario 5 were developed. Since all 50 states and DC get NMVTIS implemented in Scenario 5, we phased states in two different ways, to show the effect that timing and phasing can have on achieving benefits. The two methods used for Scenario 5 will be discussed shortly.

Scenario Summary (cont'd)

- Developed scenario definitions (states implementing NMVTIS)

States	Scenario1	Scenario2	Scenario3	Scenario4	Scenario5
AL					1
AK					1
AZ	1	1	1	1	1
AR					1
CA			1	1	1
CO					1
CT					1
DE					1
DC					1
FL	1	1	1	1	1
GA			1		1
HI					1
ID					1
IL			1	1	1
IN	1	1	1	1	1
IA					1
KS					1
KY	1	1	1	1	1
LA					1
ME		1			1
MD					1
MA	1	1	1	1	1
MI		1	1		1
MN		1			1
MS					1
MO				1	1
MT		1			1
NE					1
NV					1
NH	1	1	1	1	1
NJ			1		1
NM					1
NY		1	1	1	1
NC					1
ND		1			1
OH			1		1
OK					1
OR					1
PA			1	1	1
RI					1
SC					1
SD					1
TN					1
TX			1	1	1
UT					1
VT		1			1
VA	1	1	1	1	1
WA		1	1	1	1
WV					1
WI					1
WY					1
TOTAL	7	15	17	14	51

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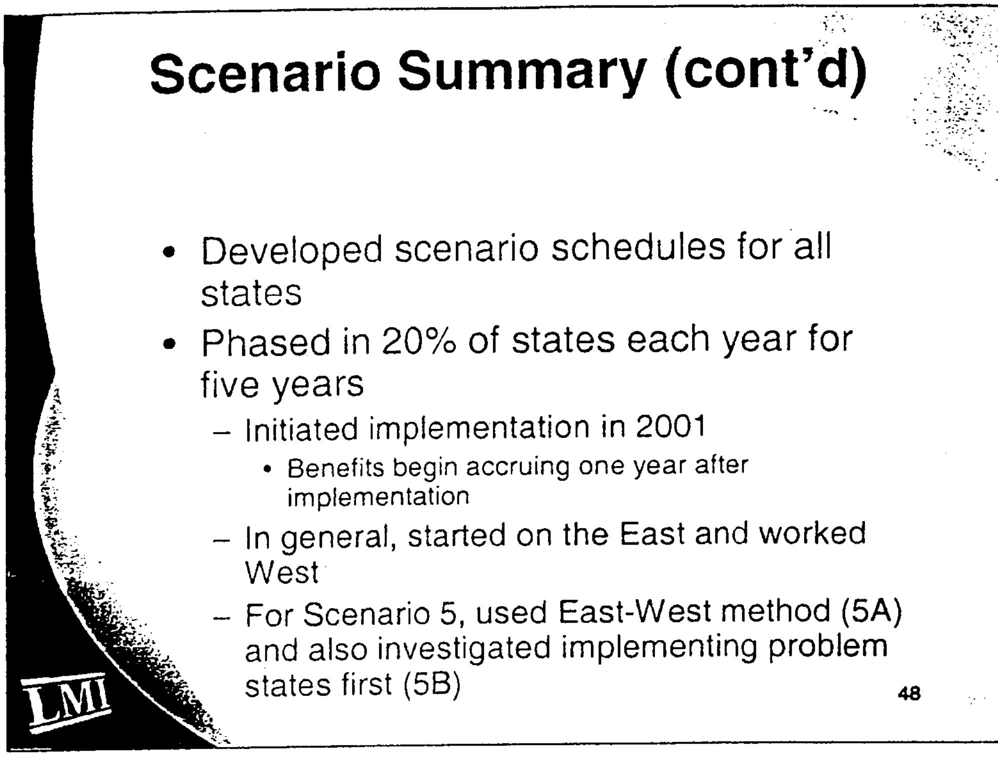
We translated the scenario definitions into worksheets showing the states implemented in each scenario. (Pilot states are highlighted).

Notice in Scenario 1, only the pilot states are included. There is some overlap between Scenarios 3 and 4, since they are both based on implementing NMVTIS in high-crime states (Scenario 3 is the problem states and Scenario 4 involves states with borders and ports, some of which are also the high-crime states from Scenario 3).



Next we developed schedules for phasing NMVTIS in to states in each scenario.

20% of the total population of states for each scenario were phased in each year for five years. We assumed 20% of the states could implement NMVTIS in 2001. The costs of implementation were accounted for in the year of implementation. The benefits began accruing the following year.

Since we did not know in what order states would implement NMVTIS for a given scenario (and in fact, the current pattern is quite piecemeal, depending on states to apply for NMVTIS funding at their own discretion), we simply chose to begin on the East Coast and work toward the West Coast, implementing 20% of states each year.

However, since Scenario 5 involved 51 state entities, we modeled two approaches, since the order states implemented NMVTIS in that scenario proved to provide substantially different benefit levels. Therefore, in addition to the East-West approach (Scenario 5A), we assumed some level of "prioritization" and implemented NMVTIS first in states with the greatest number of motor vehicle thefts. Therefore, Scenario 5B would be the most beneficial way to implement NMVTIS.

Time Phasing the Benefits

- Time phasing approach
  - Determined the maximum potential benefits for Scenario 5 at full implementation
  - Determined the maximum potential benefits for the other scenarios
  - During NMVTIS implementation, assumed gradual ramp up of benefits
  - Assumed criminals would not be completely deterred from crime
    - For Scenarios 1-4, assumed 50% of maximum potential benefits could be achieved
    - For Scenario 5, assumed 67% of maximum potential benefits could be achieved
  - Assumed 80% of maximum efficiency benefits could be achieved for Scenarios 1-4; 100% for Scenario 5

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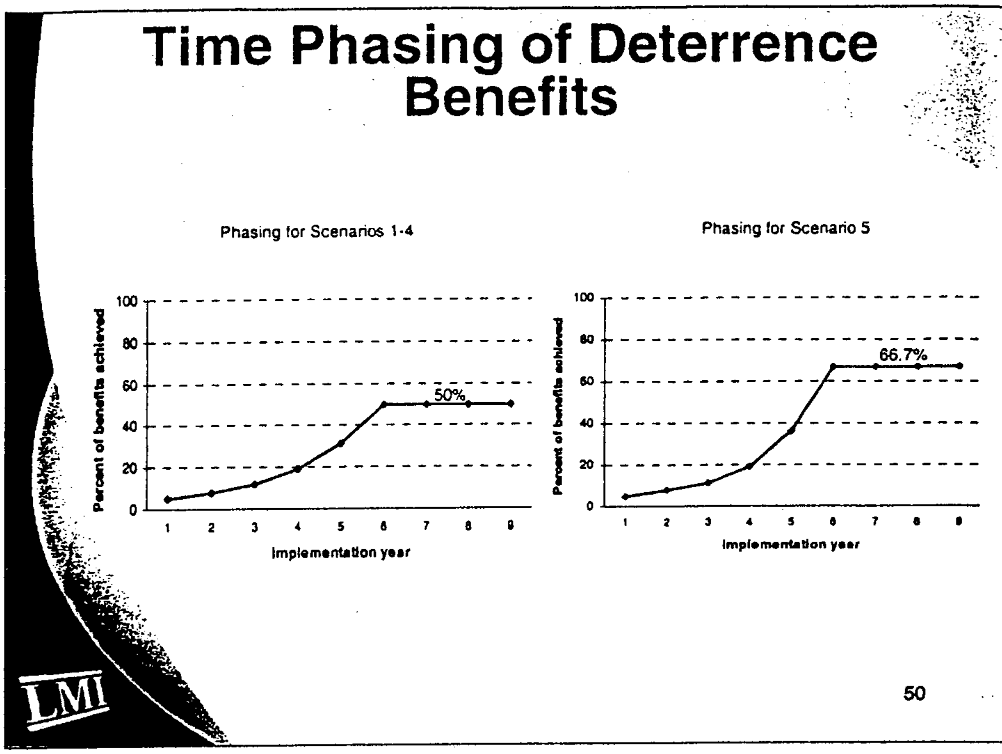
Time phasing is critical in the calculation of costs and accrual of benefits. Therefore, after determining the maximum achievable benefits for Scenario 5, we determined the maximum achievable benefits for the other scenarios.

We assumed that during the phasing in period, NMVTIS would be much less effective than at full implementation, since criminals would be working around the NMVTIS states, and there would be fewer states to share information.

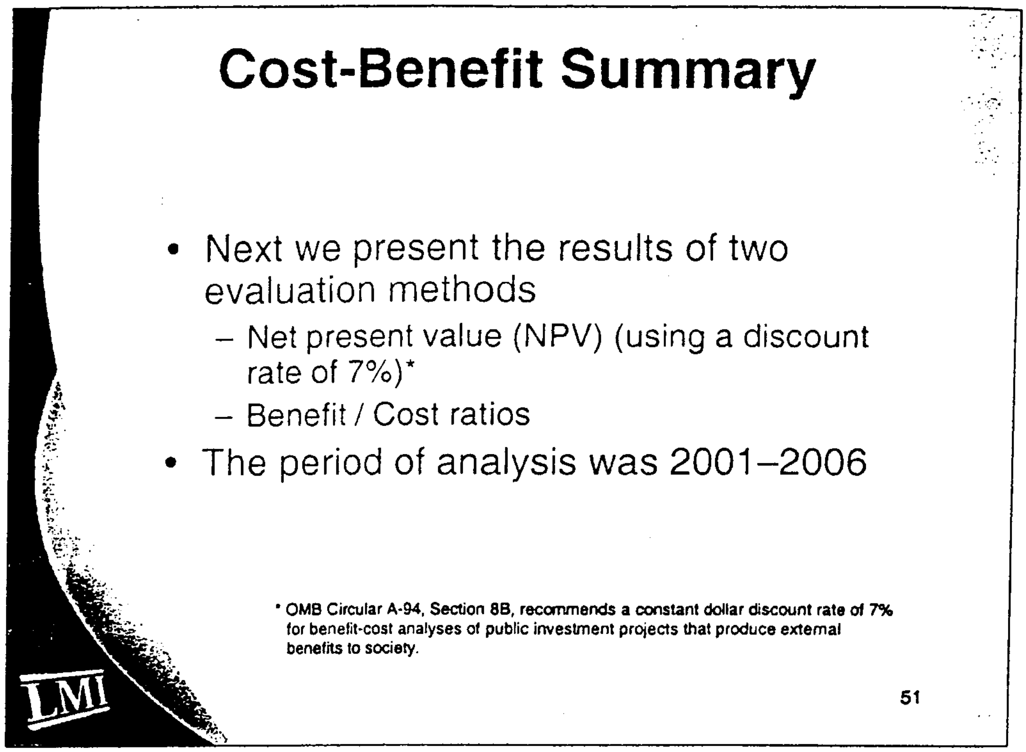
For Scenarios 1-4, we assumed crime-related benefits would only reach 50% of their maximum potential, even at full implementation. That is because there would be many other states that criminals could shift their focus toward.

Since Scenario 5 involves full implementation, we assumed at maturity, NMVTIS would reach two-thirds (67%) of its maximum potential crime-related benefits, giving credit to the innovativeness of criminals.

For efficiency benefits, since most title work is in-state, we assumed states in Scenarios 1-4 would achieve 80% of their maximum potential. That is because NMVTIS states would still have to revert to "paper processes" when interacting with non-NMVTIS states. At Scenario 5's phasing-in process, 80% of efficiency benefits would also be achieved, but at full implementation we judged that 100% of those benefits would be realizable, since titling would essentially become a paperless process at that time.



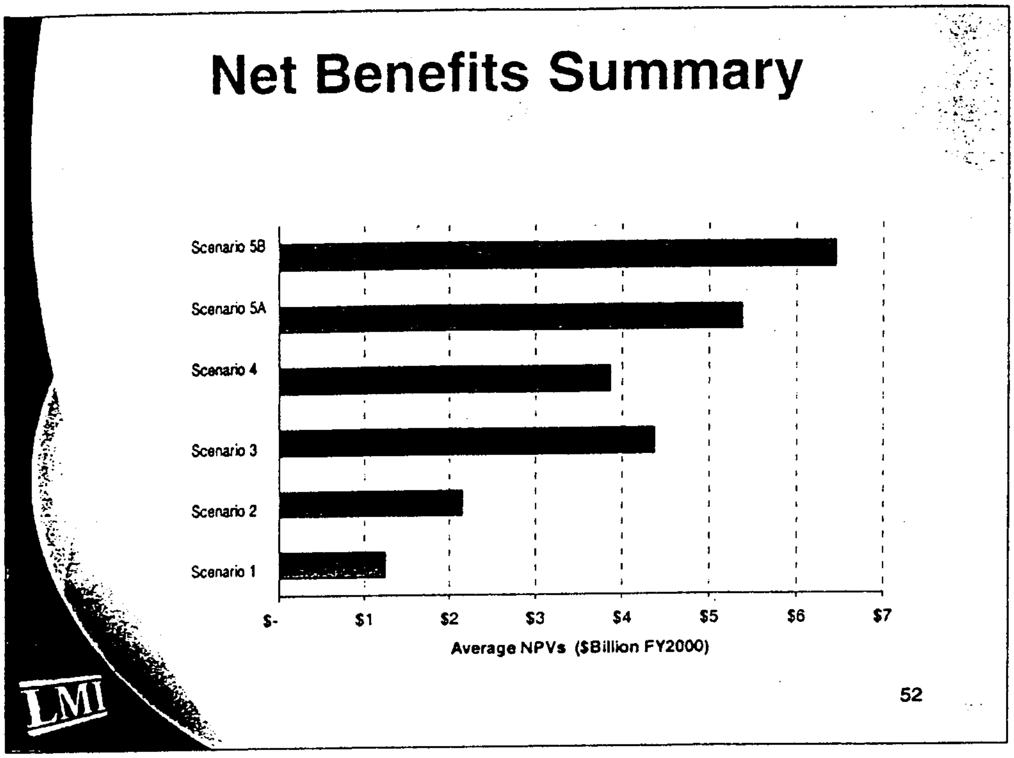
These graphs depict how benefits were restricted during the NMVTIS phase-in periods. The chart on the left applies to Scenarios 1-4, reaching a maximum of 50% of potential benefits in the 6th year of implementation (2006). The chart on the right applies to Scenario 5, achieving two-thirds of the maximum potential benefits at full phase-in during the 6th year.



We will present our quantitative results for two evaluation methods: Net Present Value (NPV) and benefit-to-cost ratios.

NPV is a way to calculate the present value of future dollars. It is based on the time value of money, assuming that a dollar earned today is worth more than a dollar earned in the future. Some readers will recognize this as opportunity cost. A discount rate is used to reduce the value of future dollars. The Office of Management and Budget (OMB) publishes Circular A-94. Section 8B of that circular recommends a constant dollar discount rate of 7% for benefit-cost analyses of public investment projects that produce external benefits to society.

We are using constant fiscal year 2000 dollars, since we conducted our cost estimates using data from that period. We did not inflate our figures.

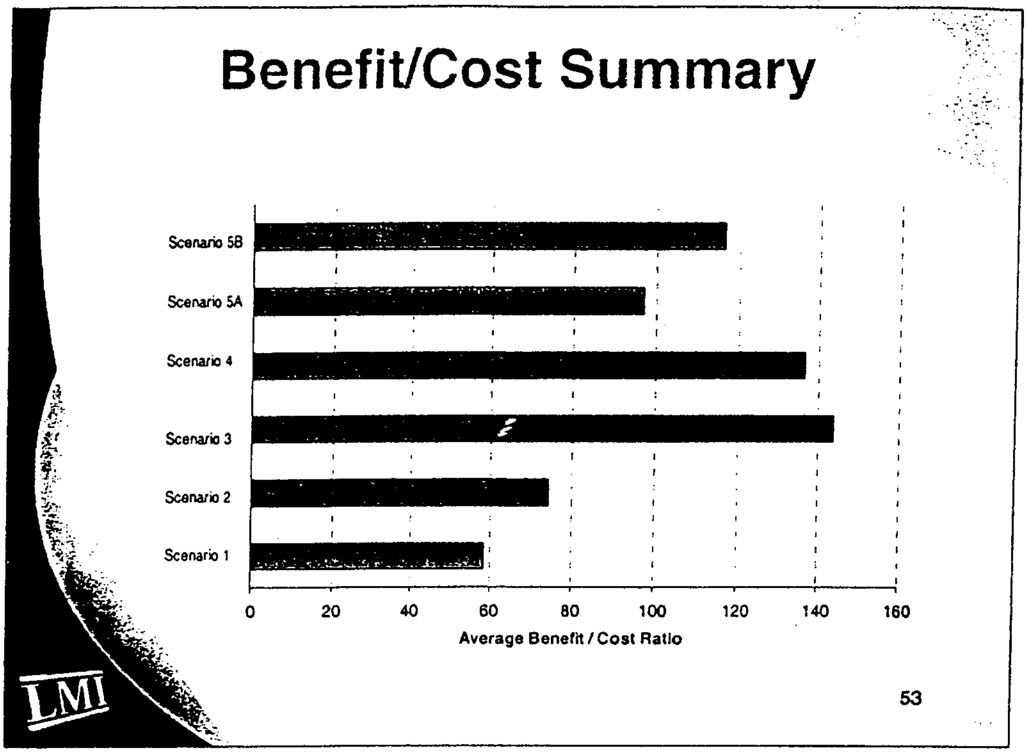


This graph presents a summary of the net benefits in terms of NPV. For each scenario, we conducted four analyses, using all combinations of high and low costs with high and low benefit values. Therefore, for each scenario, we calculated four values. This chart displays the average of the four values calculated for each scenario.

The graph clearly shows both versions of Scenario 5 having the greatest net present value – having the greatest net benefits (benefits less costs) in FY2000 dollar values.

One can observe that Scenario 1 has substantial positive benefits of approximately $1.2 billion. That average value was calculated from four values, ranging from $0.6 billion to $1.8 billion.

The first finding is that all scenarios are beneficial to implement, providing large benefits.



This graph presents a summary of benefit-to-cost (B/C) ratios. A B/C ratio is simply the present value of the benefits, divided by the present value of the costs. If the calculated value is greater than 1, the benefits "outweigh" the costs.

For each scenario, we conducted four analyses, using all combinations of high and low costs with high and low benefit values. Therefore, for each scenario, we calculated four values. This chart displays the average of the four values calculated for each scenario.

The graph shows Scenarios 3 and 4 having the greatest B/C ratios.

The finding from this analysis is that all scenarios have substantial B/C ratios and would be desirable investments.

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We conducted sensitivity analyses to identify parameters that might have a high degree of influence on the results, and to establish upper and lower limits on the potential outcome of the project. In this section we discuss those results.

Sensitivity Analysis

- For each scenario, we varied costs and benefits as follows
  - High costs, high benefits
  - Low costs, low benefits
  - High costs, low benefits
  - Low costs, high benefits
- We also varied other parameters to see the effect
  - Odometer fraud deterrence benefits
  - Inclusion of "sunk" costs

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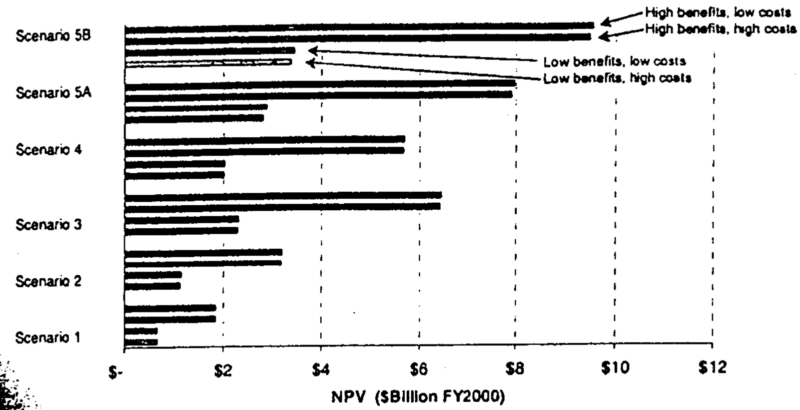
There are many uncertainties involved in cost estimating and benefit quantification. It is not realistically possible to provide one "point estimate" for future projections.

Therefore, we conducted sensitivity analyses to vary key parameters and determine if any scenarios became more preferential, based on adjusting our assumptions.

Sensitivity Analysis (cont'd)

- Varying the costs and benefits produced the following NPV results:



Since benefits dominate costs, the NPVs are not affected much by cost variances.

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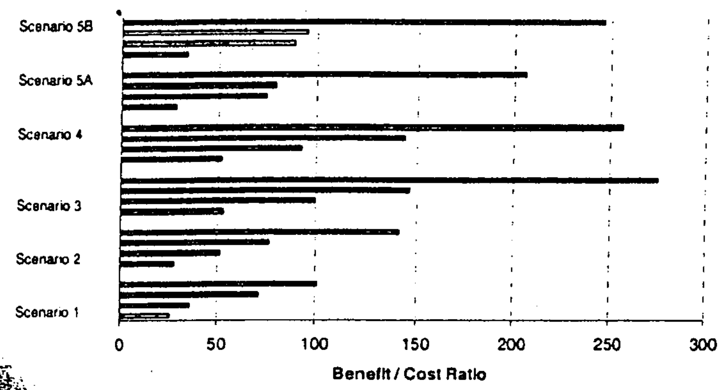
The graph shows the effect on NPV of combining different cost and benefit levels. We observe that for each scenario there are essentially two groupings. That is because the benefits are of much higher magnitude than the costs and there is little noticeable effect of varying the costs.

In this analysis, all scenarios retain their same relative ranking.

Sensitivity Analysis (cont'd)

- Varying the costs and benefits produced the following B/C ratio results:



Varying the costs and benefits provided a stair-step range of ratios.

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The graph shows the effect on B/C ratios of combining different cost and benefit levels. We observe for each scenario there are generally a stair-step pattern of increasing B/C ratios. The "grouping" seen in the NPV analysis is not apparent. That is because NPVs are conducted by subtracting (benefits – costs), and since the costs were so small the difference was negligible. B/C ratios are calculated by dividing benefits by costs, so the effect of changing the divisor is more apparent.

In this analysis, scenarios retain their relative ranking for many of the runs, but there is some shuffling.

Sensitivity Analysis (cont'd)

- The following table summarizes the sensitivity analysis results for using high and low cost and benefit estimates.

Scenario	Parameter level	NPV of Net Benefits	B/C
Scenario 1	Low benefits, High costs	$644,695,835	25
	High benefits, Low costs	$1,840,712,289	96
	Low benefits, Low costs	$652,517,441	35
	High benefits, High costs	$1,832,890,683	68
Scenario 2	Low benefits, High costs	$1,118,828,065	27
	High benefits, Low costs	$3,189,379,752	135
	Low benefits, Low costs	$1,136,173,245	49
	High benefits, High costs	$3,170,034,571	75
Scenario 3	Low benefits, High costs	$2,287,310,845	52
	High benefits, Low costs	$6,445,894,308	284
	Low benefits, Low costs	$2,308,044,175	95
	High benefits, High costs	$6,425,160,978	143
Scenario 4	Low benefits, High costs	$2,017,703,212	51
	High benefits, Low costs	$5,684,521,073	245
	Low benefits, Low costs	$2,035,073,088	88
	High benefits, High costs	$5,667,151,197	140
Scenario 5A	Low benefits, High costs	$2,783,992,147	28
	High benefits, Low costs	$7,962,842,720	200
	Low benefits, Low costs	$2,846,255,920	72
	High benefits, High costs	$7,900,578,948	78
Scenario 5B	Low benefits, High costs	$3,357,703,888	34
	High benefits, Low costs	$9,549,211,853	240
	Low benefits, Low costs	$3,419,781,875	87
	High benefits, High costs	$9,487,133,866	94

The shaded boxes represent the minimum and maximum values.

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The table shown in this chart summarizes the NPV and B/C results for each scenario using four combinations of benefit and cost levels.

One can observe that the case of Scenario 1, with the lowest benefits and highest cost estimates used, has the lowest NPV and B/C ratio. However, both measures are very positive and indicate that the project warrants investment, from a cost-benefit point of view. Scenario 5B has the greatest NPV with the high benefit/low cost case. Scenario 3 has the greatest B/C ratio with the high benefit/low cost case.

Sensitivity Analysis (cont'd)

- The relative ranking of the scenarios did not change for different cost and benefit values
- This indicates that the relative scenario rankings are robust

NPV Scenario Ranking (Highest to lowest)	B/C Scenario Ranking (Highest to lowest)
Scenario 5B	Scenario 3
Scenario 5A	Scenario 4
Scenario 3	Scenario 5B
Scenario 4	Scenario 5A
Scenario 2	Scenario 2
Scenario 1	Scenario 1

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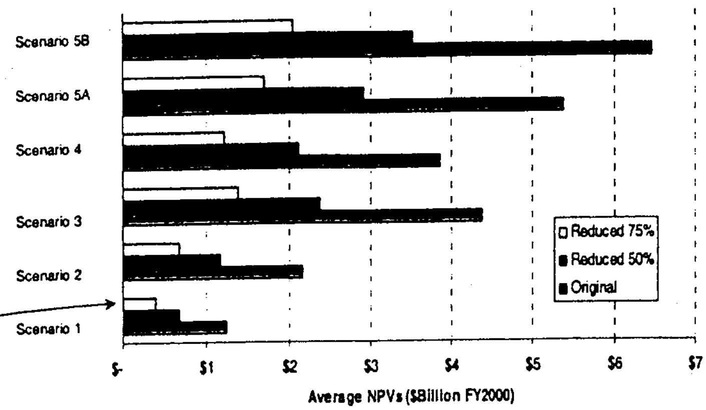
The relative order of the rank of each scenario did not change during any aspect of this sensitivity analysis. The ranking remained constant, from highest to lowest calculated value, and is illustrated in the table.

Since the rankings of the scenarios did not change for any of the sensitivity analyses, we conclude that the relative rankings are robust.

Sensitivity Analysis (cont'd)

- Reducing the odometer fraud deterrence benefit produced the following NPV results:



Even with a 75% reduction, the lowest net benefit value is $400 million.

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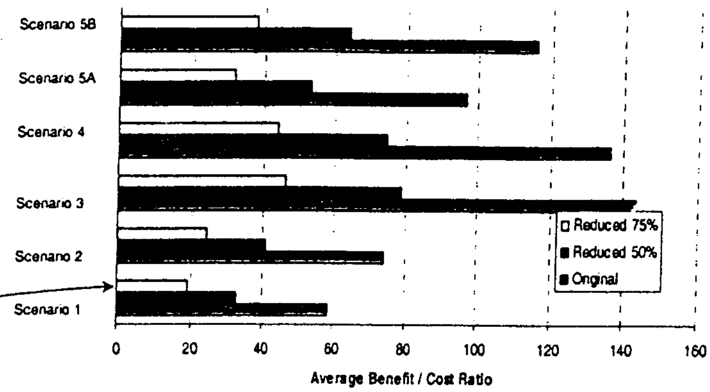
Odometer fraud reduction provided our greatest benefit, even though we were careful to use the most-conservative estimates possible. Therefore, we decided that we would investigate reducing that benefit, in case NMVTIS was less-effective at detecting and reducing it than we assumed.

In this analysis, we reduced the odometer fraud benefit by 50% and by 75%.

After severely reducing this benefit, we observe that the lowest-calculated NPV for Scenario 1 is approximately $400 million – still a substantial gain.

Sensitivity Analysis (cont'd)

- Reducing the odometer fraud deterrence benefit produced the following B/C results:



Even with a 75% reduction, the lowest average B/C ratio is 19:1.
(The lowest calculated ratio is 8:1)

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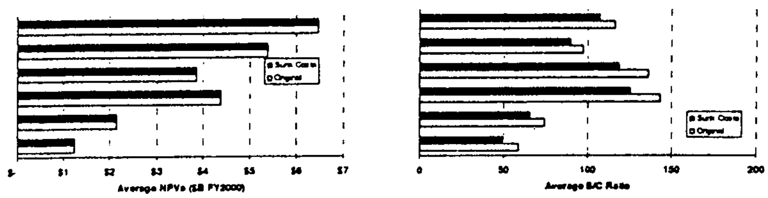
Continuing with the odometer fraud sensitivity analysis, we next investigated the effect on the B/C ratio. Again, reducing this benefit by 50% and 75% resulted in very agreeable B/C ratios.

Sensitivity Analysis (cont'd)

- Including AAMVA "sunk" costs had virtually no effect on the results:



A small effect is observed in the B/C ratio, but not in NPV.

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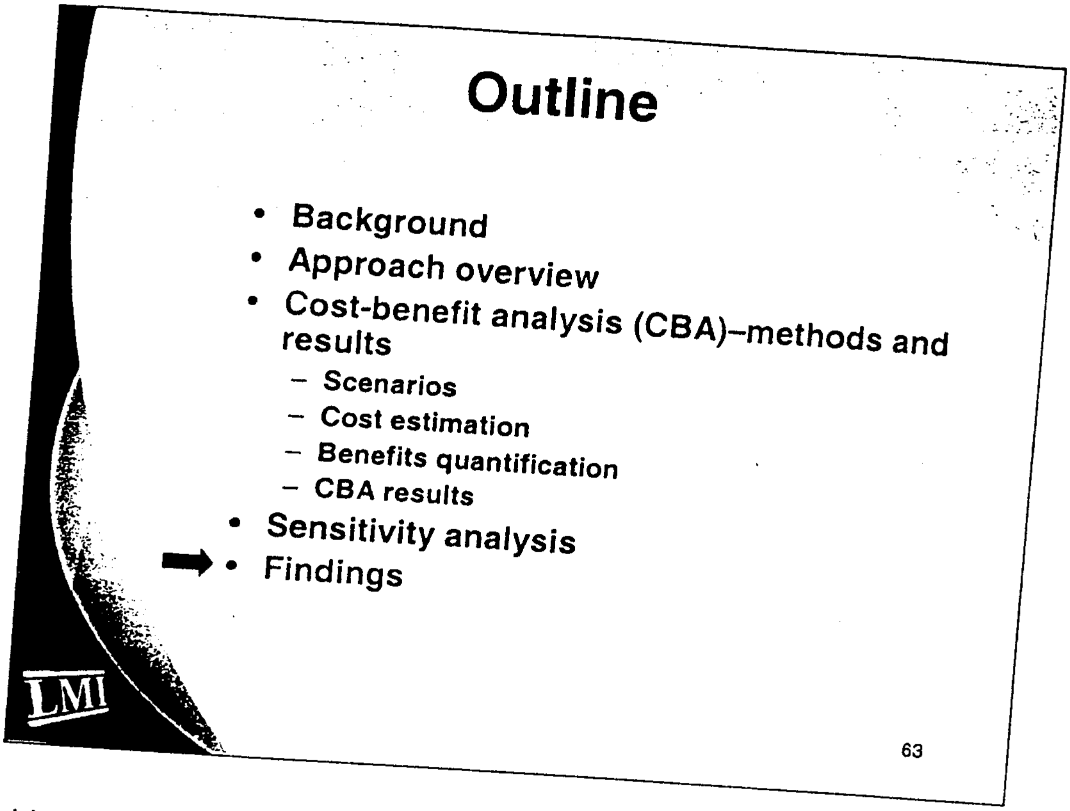
We did not include approximately $4.3 million in initial costs expended by AAMVA in the years 1998-2000. In financial terms, those costs were incurred prior to the analysis period and are therefore "sunk" – their expenditure has occurred and should not be considered when looking "from here on out."

However, in case someone was curious about the effect of such a magnitude of start-up costs, or in case we unintentionally missed some other costs that should have been considered, we conducted a sensitivity analysis of including that $4.3 million in the first year of our analysis (2001).

For brevity, we include both the NPV and the B/C charts on one page. We can see no observable effect on the NPV. We see a minor effect on the B/C results, but not enough to change our findings.



In this section of the report we summarize our findings.

NMVTIS Findings

- Both the NPV and B/C results are highly positive, and we conclude that further investments in NMVTIS can be supported from a cost-benefit point of view.
  - The more states that implement NMVTIS, the greater the benefits become, and the more expediently NMVTIS is implemented, the sooner benefits are realized.
  - The scenarios with national NMVTIS implementation with priority in states that have the most car thefts (Scenario 5B and Scenario 3) show the best realization of benefits.
  - Because the scenario rankings do not change for any of the sensitivity analyses, we conclude that the relative rankings are robust. Although estimates of future costs and benefits always contain uncertainty, we think we have established feasible boundaries

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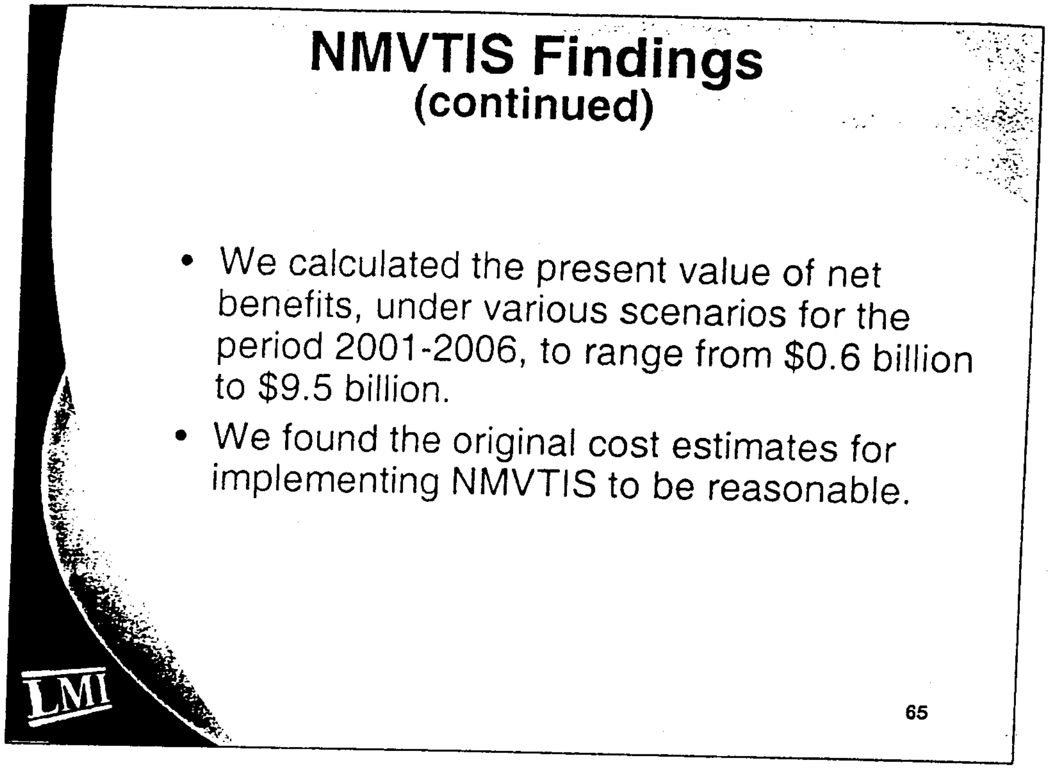
Both the NPV and B/C results are highly positive and indicate that further investments in NMVTIS implementation are highly beneficial.

The more states that implement NMVTIS, the greater the benefits become. The sooner NMVTIS is implemented, the sooner states will realize benefits.

Our sensitivity analysis shows a wide range of potential results. We cannot predict the future with great certainty. However, we feel that we have established feasible boundaries of the likely results. And no matter which part of the calculated range is more likely to reflect reality, all indications are that NMVTIS is a high pay off investment.



We found that NMVTIS—if it is fully implemented in all 50 states and the District of Columbia, and if it is 100 percent effective—can achieve benefits in the range of $4 billion to $11.3 billion annually.

Because there are many obstacles to full national implementation, we evaluated the costs and benefits of NMVTIS over a range of scenarios.

In all of the scenarios investigated, we found the net benefits of NMVTIS to be substantial. After accounting for costs and benefits during 2001–2006, we calculated the present value of the net benefits to range from $0.6 billion to $9.5 billion (in year 2000 dollars).

We found the original cost estimates for implementing NMVTIS in the states and to establish a central management and coordination function at AAMVA to be reasonable.

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LMI is pleased to present this report. Questions or comments can be addressed to the address noted here.

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