Cross-Modal Work Helps OMC Improve the Safety of Commercial Transportation

Work by the Volpe Center's Economic Analysis Division to develop a safety fitness profile of motor carriers has its roots in a project that was initiated a decade ago to develop a safety performance monitoring system for air carriers. The application of a similar technology solution to two seemingly disparate projects exemplifies the cross-modal approach most effectively used by the Volpe Center in its project work for clients.

Research performed or methods developed by Volpe Center staff members on one project often has direct application in other areas. Indeed, access to the wealth of research and system development experience acquired through work on thousands of projects over the past 25 years is one of the most significant client advantages of working with the Volpe Center on technology application projects.

This "cross-modal" approach to solving client problems is best evidenced by work currently being conducted by the Volpe Center in conjunction with the Department of Transportation's Office of Motor Carriers (OMC) to deploy a national "safety fitness" program for the nation's commercial trucking fleet.

The program, called the Commercial Vehicle Information System (CVIS), is built around a safety analysis algorithm called SafeStat, which constructs a profile on commercial vehicle operators whose activities are subject to the Federal Motor Carrier Safety Regulations (FMCSRs). This profile can then be used by federal inspectors and state authorities to identify potentially unsafe carriers and to take the necessary actions to reduce the safety risk to the public.

SafeStat, which is now being evaluated in a CVIS pilot program in five states, has already received high marks from OMC officials, who also plan

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to use it as the basis for determining which commercial operators to target in its on-site Compliance Review (CR) program. But while SafeStat represents a breakthrough for the DOT in evaluating the safety of commercial motor carriers, it is based largely on pioneering efforts by the Volpe Center for the Department of Defense (DoD) in development of a safety monitoring system for air carriers, which began a decade ago.

An Airline Tragedy Brings Action

On December 12, 1985, an Arrow Air charter flight carrying more than 200 U.S. military personnel home for the holidays crashed in Gander, Newfoundland, killing all on board.

Assistant Secretary of Defense for Acquisitions and Logistics James P. Wade responded to Congressional concerns by initiating the DoD Passenger Airlift Policies & Procedures Review (referred to as the Wade Commission). The Commission made several recommendations to increase safety oversight of air carriers with whom the DoD did business. These recommendations resulted in the establishment of a new organization—the DoD Air Carrier Survey and Analysis Office. This new office was directed to develop an objective system of indicators for monitoring the performance of existing and potential charter air carriers in several critical areas. A centralized database and air carrier analysis support system was conceived, designed, and developed by a DoD/Volpe Center team. A broad set of performance measures and indices related to air carrier safety was developed to identify air carriers for DoD oversight and possible action to correct detected deficiencies. The Air Carrier Analysis Support (ACAS) system was designed to support DoD analysts in five broad performance areas: (1) Accidents and Incidents; (2) Operations; (3) Maintenance; (4) Service Quality; and (5) Finances.

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How ACAS Works

The ACAS system collects data on air carrier safety and performance from more than 30 sources. For example, data on a carrier's operations and maintenance is obtained from the regular inspections and periodic safety checks conducted by the FAA and the DoD. Information on safety events, which include crashes, near mid-air collisions, and other incidents, comes from data maintained by the FAA and the National Transportation Safety Board (NTSB). ACAS also collects carrier data covering service quality issues, including on-time performance, as well as financial information from airline statistics reported to the DOT and private sources such as Dun & Bradstreet.

All the basic data sources are polled at regular intervals to ensure that the performance measures and indicators, which are reviewed daily by the DoD analysts, are operating on the latest data. Each analyst has responsibility for one performance area, continuously monitoring all DoD air carriers to alert the command immediately when significant changes have occurred and special attention is required by one or more air carriers.

ACAS processes the raw data obtained from all sources through a complex series of algorithms, which moves information from the lowest level (i.e., greatest detail) up through succeeding layers. The algorithms focus the analyst's attention on key indicator values, which range from 1 (very good) to 5 (very bad), with 3 being average or normal. A highlighted change in any indicator can be quickly explored by "drilling down" through several layers of increasing detail to expose the underlying data element that caused the change in the indicator value.

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The conceptual design, definition of functional requirements, formulation of algorithms, development of standardized data collection and processing methods, database management procedures, computer workstations, user interfaces, user manuals, training, etc., were developed jointly by the Volpe Center team and the customer via a standing working group (and subgroups) consisting of user representatives from the DoD and the FAA that met regularly. During the ACAS prototype development, the operational concept, analytical structure, data sources, key algorithms, and final use of ACAS were reviewed with the NTSB, industry groups, and academia.

The DoD/FAA/Volpe working sessions provided the means of merging the Volpe Center's analytical expertise with the DoD/FAA's experience, which resulted in an analysis support tool that was effectively used by the DoD and the FAA for several years until the FAA incorporated ACAS into a broader-based tool, the Safety Performance Analysis System (SPAS).

ACAS developed via a prototyping process involving the ultimate users in the process of design, development, test, and operational applications (Mark I–IV) from 1987 through 1991. The Volpe Center provided customers with host computer support, system maintenance support, analytical support, and database management support during this period.

Further Developments with ACAS

Congress, buoyed by the success of the ACAS program in creating safety profiles for only air carriers providing DoD contract services, began to explore the feasibility of a similar system to evaluate the safety performance of all air carriers providing commercial air service to the general public.

The Federal Aviation Administration initiated a new project with the experienced Volpe Center team to expand upon ACAS in developing a system that could support FAA Safety Inspection and airworthiness certification effort. SPAS, the FAA system, has essentially the same objective and conceptual structure. It focuses FAA resources on those air carriers most in need of closer attention by monitoring a number of performance measures and calling attention to an air carrier when it deviates from some normal pattern. The SPAS project has been conducted in a similar manner with working groups composed of the ultimate users (which in this case are vastly greater in number) and the

Volpe Center development team. SPAS has evolved though several versions, and has now incorporated so much of the original ACAS that the DoD has discontinued support of ACAS as a separate system and is relying on SPAS for the safety oversight of its contract air carriers.

Monitoring Safety Among Motor Carriers

Air carrier safety is certainly a highly visible issue, and tragic accidents like the 1985 Arrow Air crash helped to galvanize public support for action to deal with problems of safety among air carriers. But the nation's roadways present a far greater safety threat to the general public. In fiscal year 1995, for example, the NTSB reported that more than 41,000 people were killed in motor vehicle accidents. Trucks and other commercial vehicles accounted for approximately 13 percent of those fatalities.

The OMC is charged with the responsibility of enforcing federally mandated safety requirements for truck and bus operations. Their mandate extends to all commercial vehicles weighing in excess of 10,000 pounds engaged in interstate travel. The OMC also regulates any bus that carries more than 15 passengers as well as carriers that transport hazardous cargo, even when those vehicles do not cross state lines.

The logistical problems facing OMC in enforcing safety requirements for trucks and buses overshadow the problems facing the FAA in identifying unsafe air carriers. Trucks and buses are the backbone of our nation's transportation system, moving people and goods to every corner of the country. Whereas commercial air carriers number in the hundreds, there are more than 350,000 motor carriers and independent truckers, including private, for-hire, and contract carriers who carry goods in interstate commerce. All told, millions of commercial vehicles travel U.S. roads and highways each day.

The OMC focuses most of its enforcement efforts on the interstate motor carriers and determines compliance with federal regulations through on-site compliance reviews. Even with its available resources, however, the OMC can conduct only a small number of compliance reviews per year. During 1995, for example, less than 10,000 such assessments were actually conducted by OMC personnel. That means that the majority of commercial motor carriers operating on the road never receive an on-site review.

Toward a Motor Carrier Safety Fitness Program

By most accounts, the OMC is one of the leading government agencies when it comes to information systems. Its Motor Carrier Management Information System (MCMIS), for example, captures information obtained from the Form MCS-150 application required of every carrier engaged in interstate trucking. MCMIS essentially tracks carriers by their size, capturing data on the number of trucks and drivers per carrier as well as a description of the type of cargo typically carried.

In addition, MCMIS tracks safety-related data, such as accident reports,

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enforcement actions, citations, and roadside inspection results. Therefore, it is a valuable resource that could be used by the OMC as the basis for its safety evaluation program. However, OMC lacked a systematic approach to maximize the use of this data in determining the compliance and safety fitness of motor carriers. In 1993, OMC approached the Volpe Center to devise an improved motor carrier safety fitness determination process. The goal was to fully utilize MCMIS and to access additional data on safety-related issues—such as accident and enforcement data and reports on roadside inspections—that could be used to better identify unsafe carriers.

Interestingly, the objectives of the OMC in developing a safety fitness system for profiling motor carriers also fit well with a Congressionally mandated initiative being undertaken by the OMC and the states: that of developing a system to link state commercial vehicle registrations with motor carrier safety performance. This program, the Commercial Vehicle Information System (CVIS), is a Congressionally mandated federal/state cooperative charged with identifying unsafe carriers that could be targeted for correction action. In order to test the feasibility of CVIS, Congress designated OMC as the federal participant in a five-state pilot program, along with officials from Iowa, Colorado, Indiana, Minnesota, and Oregon, and organizations with an interest in motor carrier safety.

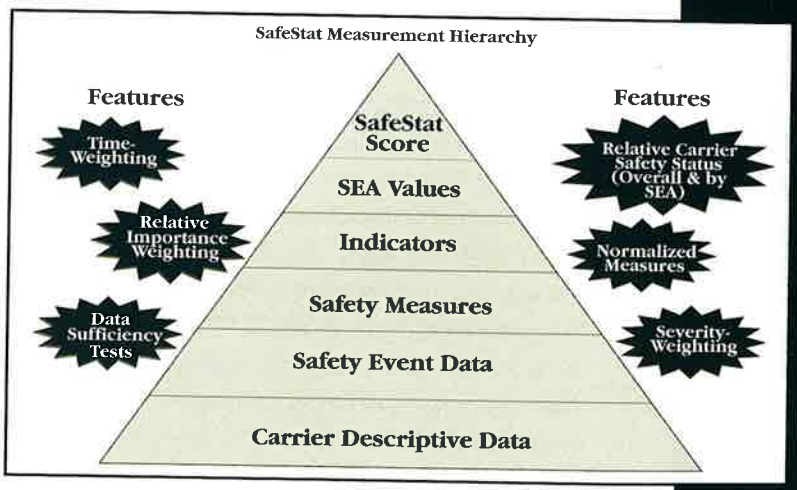
Volpe Center staff quickly found themselves at the heart of OMC's efforts to develop an underlying data-driven analytical system that would provide comprehensive information on motor carrier safety as well as the information support necessary to achieve the objectives of the CVIS program. Volpe Center personnel recognized from the start that the project had many similarities with the Center's earlier work in developing an air carrier safety program for the military. Indeed, it was this experience that led Dale Sienicki of the OMC Analysis Division to select the Volpe Center to develop an improved safety fitness determination process for motor carriers.

For Don Wright, Volpe Center Project Manager in charge of the OMC development effort, it was a familiar situation. Wright had also played a key role in the development of the ACAS and SPAS systems for air carriers and was in a good position to take advantage of the similarities between those projects and the requirements of the OMC program.

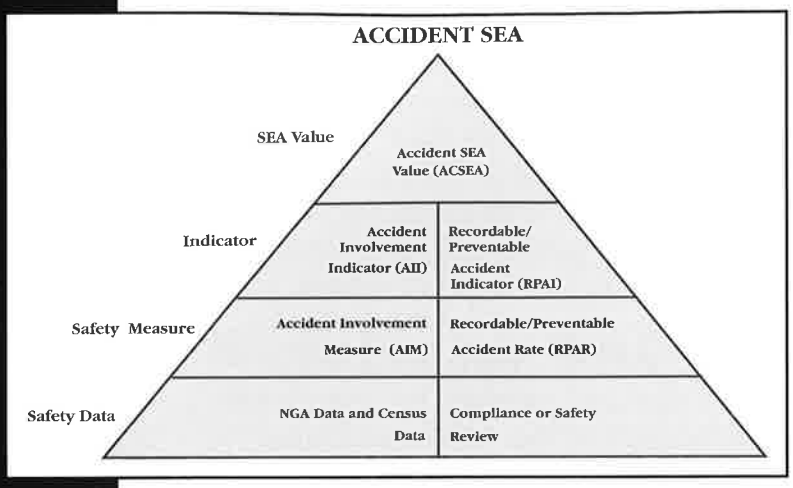
"We all like to talk about cross-modal benefits," says Wright. "But then we are always groping for an example. This was a real example. Many of the same techniques, methods, and indicators that we developed for air carriers are relevant to motor carriers."

SafeStat System Targets Unsafe Carriers

The application of Wright's earlier work for air carriers to the requirements facing OMC resulted in the development of the Safety Status Measurement System, or SafeStat for short. SafeStat



A carrier's composite safety score is weighted by a number of additional factors to provide the most objective assessment possible.



The complex profile of the accident SEA is characteristic of the detail that SafeStat can bring to its motor carrier analysis.

is a data-intensive, automated safety analysis system that regularly obtains data on a variety of motor carrier safety performance measures and produces safety indicators and a safety assessment for each carrier in each of four separate Safety Evaluation Areas (SEAs), including accident statistics, driver performance, vehicle condition, and safety management. SafeStat's algorithms also produce a final overall "SafeStat Score" for each motor carrier that can be used to target specific carriers for further action.

As with the ACAS system for air carriers, SafeStat collects data on motor carrier safety from a variety of sources, including OMC's own MCMIS system, which includes accident data from local and state police accident reports, roadside inspections conducted under the DOT's Motor Carrier Safety Assistance Program, and on-site compliance reviews conducted by OMC inspectors and state enforcement authorities. New data is uploaded continuously to ensure that SafeStat has access to the most current data in formulating carrier assessments.

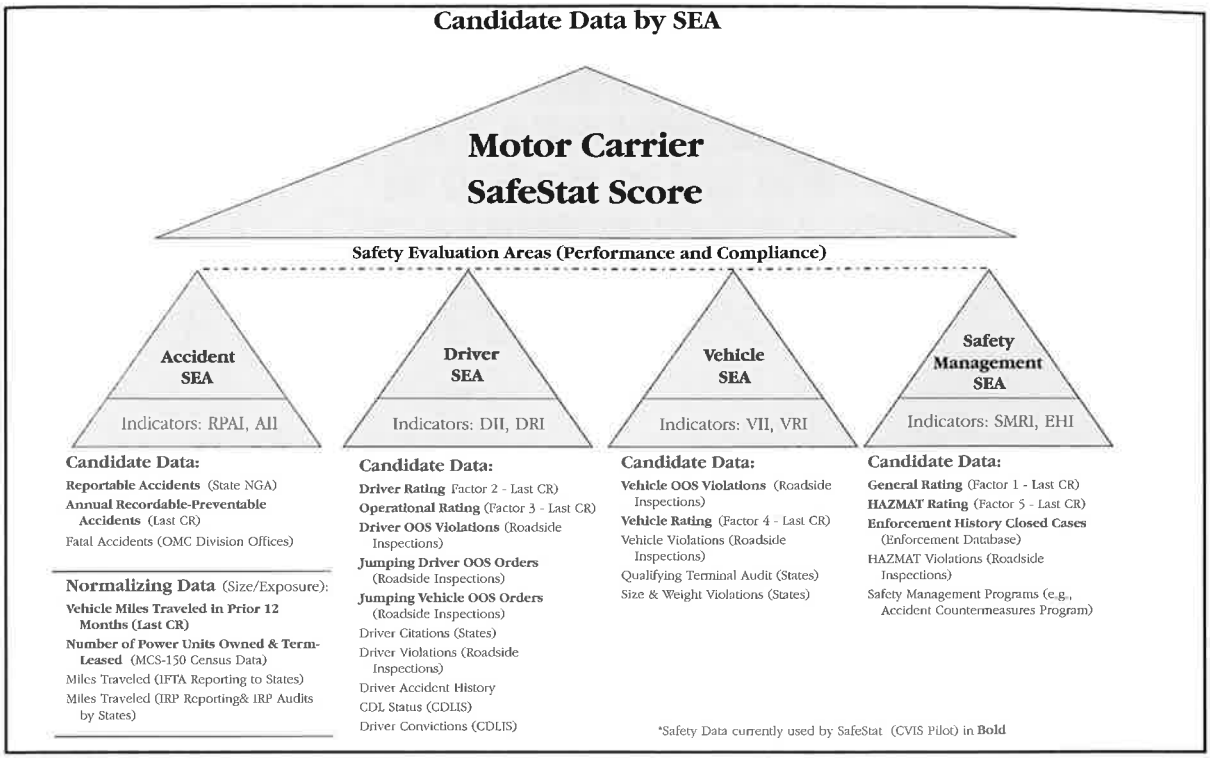
The scores produced by SafeStat can be used in a variety of ways by state and federal officials. Periodic reports produced by SafeStat can identify carriers with high scores in any or all of the SEAs evaluated by the system and alert officials to take appropriate action depending on the nature and extent of the safety deficiencies. Federal inspectors can issue "Out of Service" orders, while state registry officials can revoke vehicle registrations, effectively taking unsafe carriers off the road. State officials can also issue warning letters to those carriers whose safety profiles indicate less severe risks.

However, follow-up actions do not rely exclusively on ratings generated by SafeStat. The system also provides for a manual review of individual carrier scores by officials familiar with both the carrier and the SafeStat system. These reviews can help to identify—in advance—anomalies in the scoring that can be explained by qualitative information not available to the system. Such reviews can prevent unnecessary enforcement actions and minimize negative anecdotal evidence about the effectiveness of the system.

Pilot Program Yields Positive Results

As with the air carrier safety project, Wright and other Volpe Center staff members conducted extensive research with federal and state safety officials as well as transportation industry experts to determine the most appropriate factors in evaluating the safety of motor carriers. A pilot test of the SafeStat system was initiated in early 1995 in the lead state of Iowa and later in the other four states participating in the CVIS program.

The SafeStat system has been refined continuously during this trial period. Information in additional safety categories has been added to the carrier analysis, and the algorithms used by the system have been enhanced to better



SafeStat utilizes data from a variety of different sources to provide a composite score of each motor carrier's safety fitness.

evaluate actual motor carrier safety performance. In addition, an evaluation of the effectiveness of SafeStat has verified that the safety index scores assigned by SafeStat to motor carriers can accurately predict which carriers are at greater risk of future accidents.

The support of the Volpe Center and the importance of SafeStat to the success of CVIS was emphasized by Bonnie Bass, the OMC CVIS project manager, in a letter of appreciation to the Center. "The development of SafeStat represented a major undertaking fraught with numerous difficulties and short deadlines," she wrote. "The importance of SafeStat to the overall CVIS project cannot be overemphasized."

Results of the initial pilot project are now being compiled and an evaluation of CVIS is now being prepared for Congressional review. But there have already been a number of outcomes that confirm the effectiveness of the SafeStat system.

First, as the use of SafeStat has expanded in those states that participated in the pilot program, the quality of carrier safety data coming back from state databases has substantially improved. Wright of the Volpe Center believes that increased usage has provided an incentive to ensure that the quality of data is as high as possible. "There's now a major push to improve the quality of data being imported into the system," says Wright. "People have the incentive to provide better quality data, now that they have the opportunity to use it in enforcement efforts."

Second, OMC has been sufficiently impressed with the usefulness of the SafeStat system that it is planning to use the motor carrier safety fitness scores as the basis for identifying carriers for its

own on-site compliance review program. Currently, OMC relies mainly on a much simpler algorithm and complaints from the field to identify carriers at greatest risk. However, with the strong correlation between the carrier safety scores produced by SafeStat and carrier accidents, OMC officials clearly believe that SafeStat can help them to better target its own ongoing enforcement efforts. Such an approach supports OMC Administrator George Reagle's goal of making OMC safety fitness programs more data driven and performance based.

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But perhaps the most important indicator of the acceptance of the SafeStat system comes from the trucking industry itself. Gene Borgoffen, president of the National Private Trucking Council, calls SafeStat "a powerful agent for change" in the trucking industry. According to Borgoffen, "SafeStat is the first essential step in moving our approach to truck safety management from measuring the wrong things to measuring the right things, and focusing enforcement on those whose performance warrants it."

Resources

"An Acronym to Remember," *Private Carrier,* April 1996.

"CVIS May Be The Future of Safety Enforcement," *Private Carrier,* September 1995.

"Motor Carrier Safety Benefits from Airline Experience," Volpe Center internal document.

Notice of Proposed Rulemaking, FHWA Docket MC-96-XX.

"FHWA to Evaluate Safety Performance," and "Measuring Safety Performance," *Transport Topics,* February 3, 1997.