Legislative Impact on the Design and Operational Safety of Large Trucks in the United States

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Legislative Impact on the Design and Operational Safety of Large Trucks in the United States

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Abstract

U.S. truck manufacturers, in concert with the USDOT, have made significant progress in advancing the state-of-the-art in vehicle safety during the past four decades. This paper provides an overview of the regulatory impact associated with the 1956 Federal Aid Highway Act (and subsequent amendments), the 1966 National Traffic and Motor Vehicle Safety Act, and the1980 Motor Carrier Act. But, more significantly, a substantial portion of the overall improvement in safety has resulted from non-regulated advancements that have been instituted voluntarily by truck manufacturers.

The paper provides a concise summary of all vehicle related *regulations* emanating from the above-mentioned enabling *legislation*. Truck manufacturers, both individually and collectively through their trade association, became pro-actively involved early on (late 1960's) in the government rule-making process. As part of this early effort, manufacturers became vitally concerned that the USDOT's initial primary focus on promulgating vehicle regulations was not adequately supported by necessary research and problem-identification studies. To compensate for this shortcoming, truck manufacturers collectively developed and financially supported an aggressive 25-year research program to address important emerging vehicle/driver related safety issues.

As part of the evolving legislative process, truck manufacturers successfully implemented a leadership role in promoting a cooperative working relationship with the government and other segments of the industry as a means of addressing a host of real-world safety issues and concerns. Examples highlighted in the paper include: braking-handling-stability; crashworthiness/restraint systems; driver environment/anthropometrics; driver fatigue; fuel system integrity; truck size & weight effects; splash & spray; ride quality; tire/wheel systems; and underride/conspicuity studies.

As a way of illustrating the effectiveness of the government/industry cooperative process, the paper provides an overview of a 20-year chronology on vehicle "crashworthiness" developments. As part of this chronology, during the decade of the 1980's the U.S. experienced a dramatic 60% decline in the annual number of truck occupant fatalities. More impressively, during this same time period the number of licensed fleets increased by 135% and the annual vehicle-miles-traveled increased 40 percent. Although it is beyond the scope of this paper, similar chronologies of progress can be portrayed for most of the other above-mentioned topics.

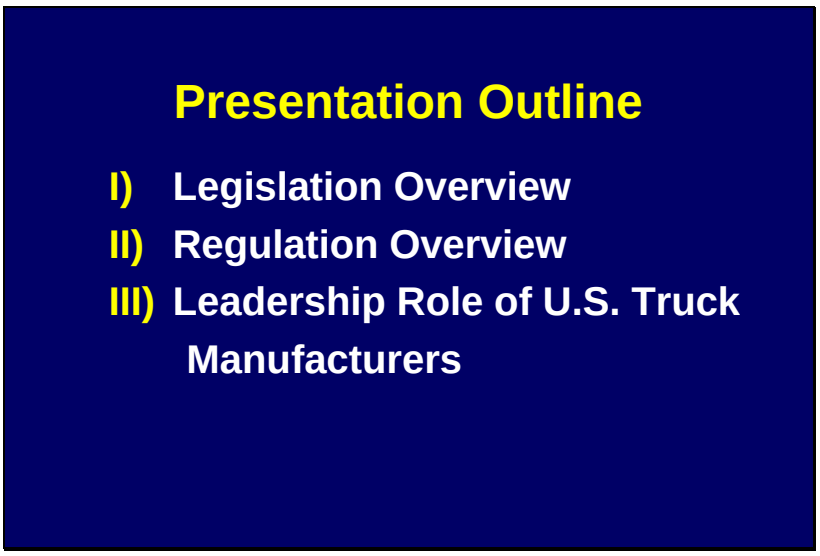
Introduction

Developments in the legislative environment have had a profound impact on heavy truck safety during the past four decades. As background, the author has been involved during this entire time frame in the truck engineering and technical legislation field, retiring from International Truck & Engine Corpo ration (parent company is Navistar International Corporation) in August 1996 with 36+ years service. Since retirement he has continued to participate in numerous public forums and provides technical/legal consulting services to a broad segment of the trucking industry.

The remainder of the content of this paper is presented in the following series of slides:

Title Slide

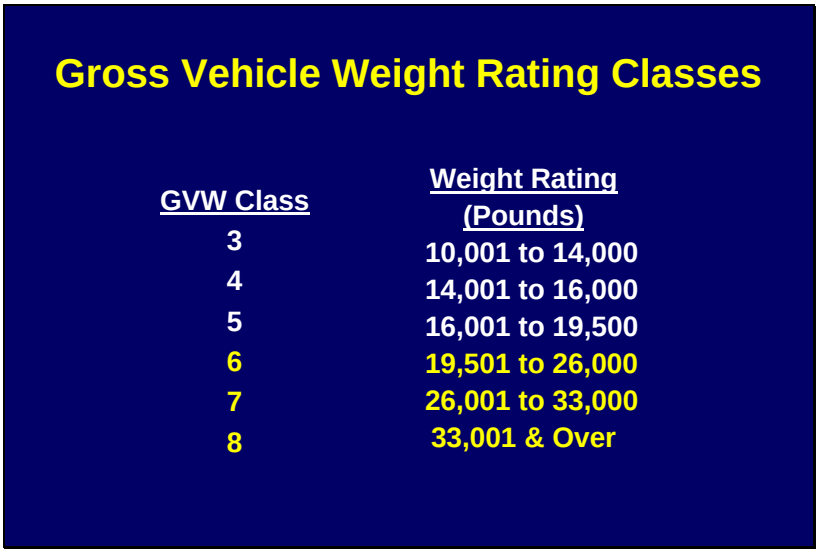
Slide 1



My presentation will summarize legislation as enacted by the U.S. Congress; and regulations as promulgated by various governmental Agencies. I also want to emphasis the leadership role of International Corporation, specifically, and U.S. truck manufacturers, in general, of pro-actively addressing many key societal issues.

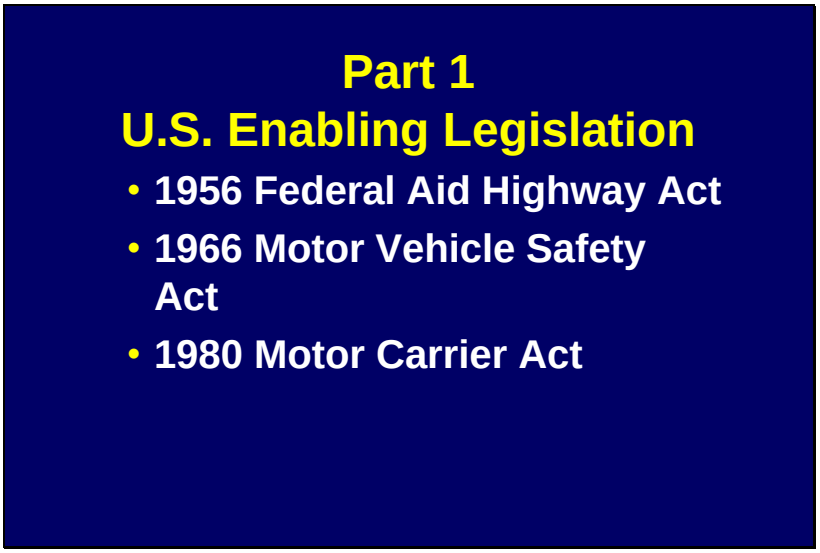
As I go through the presentation, you will see that many public concerns and substantive issues have been resolved effectively, and on a voluntary basis, by International Corporation and other truck manufacturers; thus precluding the need for onerous, non-productive, and inhibitive regulations.

Slide 2



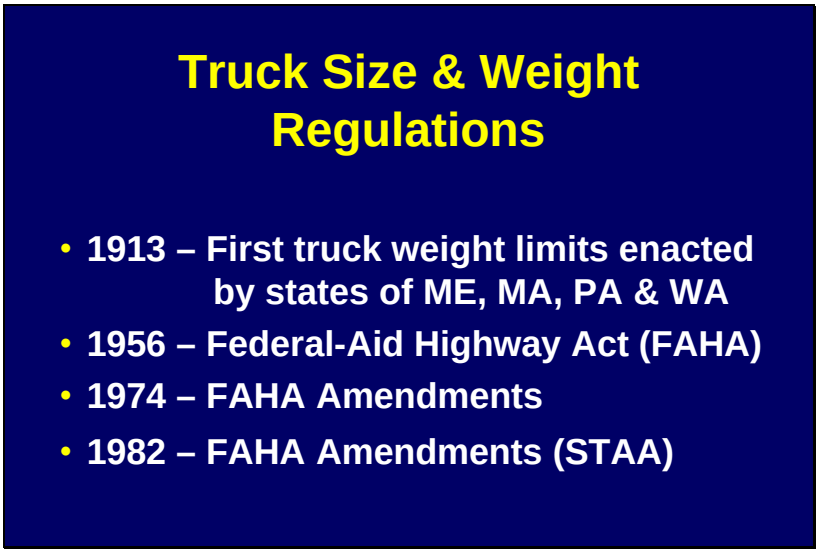
With the exception of some brief historical comments on the Scout and Light-Line models, my presentation covers trucks in GVW Classes 6, 7 and 8.

Slide 3



I will briefly overview the 1956 Highway Act, the 1966 Motor Vehicle Safety Act, and the 1980 Motor Carrier Act.

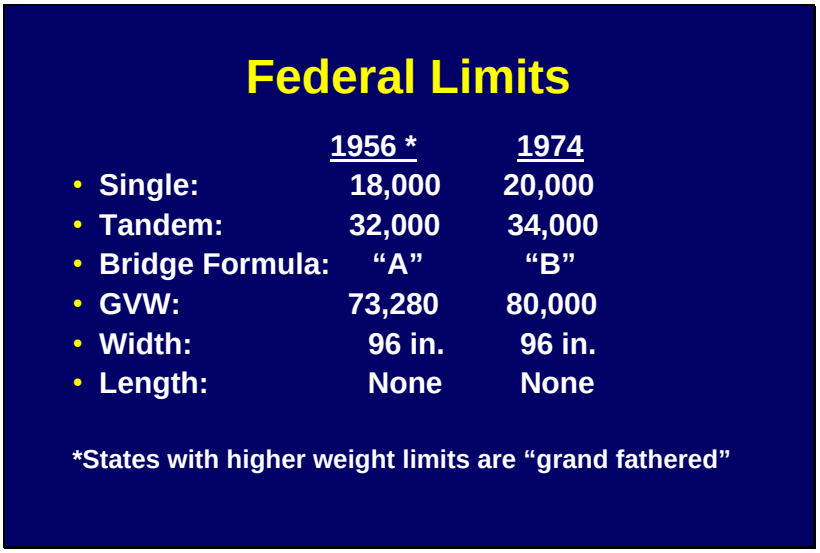
Slide 4



Without question, size and weight regulations have dictated the basic configuration of truck design more than any other regulation in the history of trucking. Following the initial 26,000 lb. gross vehicle weight limit set by four states in 1913, all states eventually enacted a proliferation of differing vehicle size and weight limits.

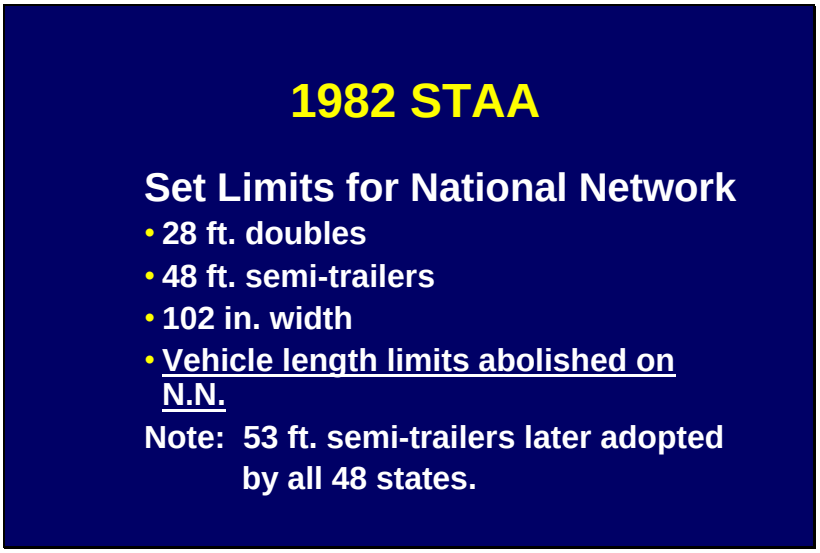
The first federal legislation signed by President Eisenhower in 1956 brought about national uniform standards for the 44,000 mile Interstate Highway System. Substantive amendments to the Federal-Aid Highway Act were enacted in 1974 and 1982.

Slide 5



Single axle, tandem axle, and gross vehicle weight limits as established in 1956 were increased in 1974. Higher weight limits, which previously existed in about half of the states, are still "grand fathered." As noted, individual states have exclusive jurisdiction of vehicle length limits.

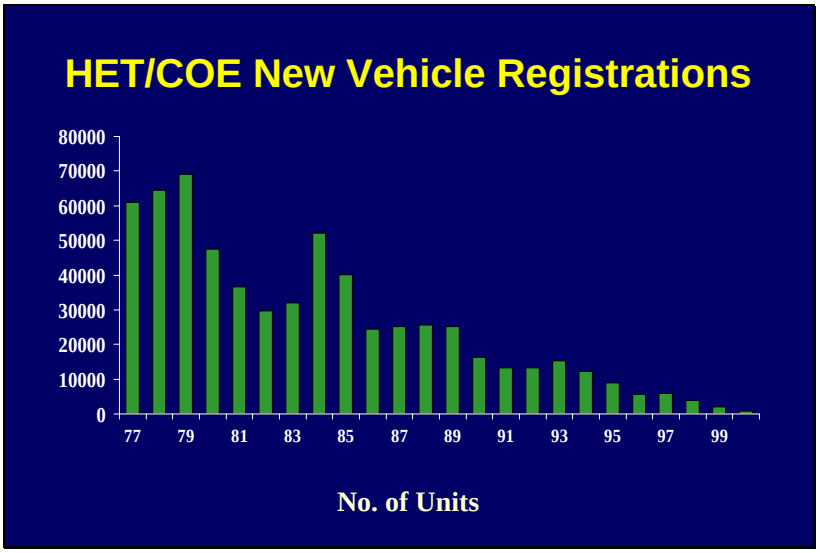
Slide 6



The 1982 Surface Transportation Assistance Act stipulated that 28 ft. doubles, 48 ft. semi-trailers and 102 wide vehicles be allowed to operate any where on the National Network. Another significant change brought about by the 1982 Act abolished vehicle overall length limits on the National Network.

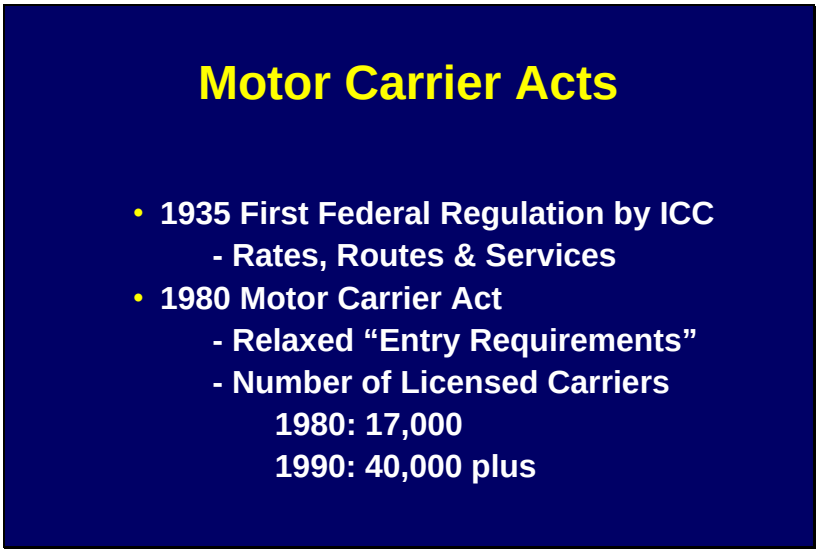
This amendment allowed motor carriers the option of replacing cab-over tractors with longer conventional models. Permissive use of 53 foot semi-trailers was later adopted by all 48 states.

Slide 7



As a result of the 1982 STAA, COE sales have steadily declined from a peak of 70,000 units per year to 868 units in year 2000. International discontinued sale of its COE model in the U.S. in 1998, and I believe there are still two COE manufacturers in the U.S.

Slide 8



In 1935, Motor carriers became regulated by the Interstate Commerce Commission for the first time. The 1980 Motor Carrier Act substantially de-regulated motor carriers, and as a result the number of licensed carriers increased from 17,000 to over 40,000 during the next ten years.

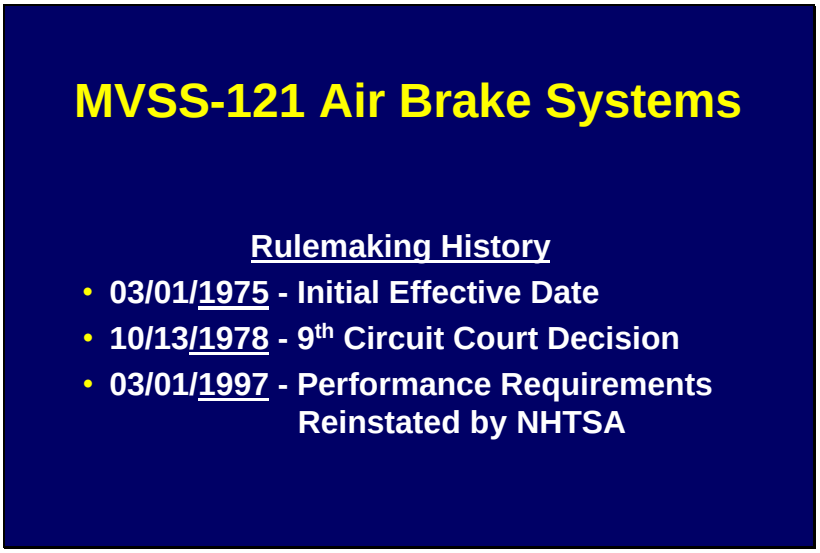
Slide 9

The rulemaking process of most federal agencies adheres to the Administrative Procedures Act requiring that all rulemaking notices be published in the Federal Register. Vehicle manufacturers of course have the responsibility of monitoring and responding to all pertinent agency notices.

In retrospect, the fact that the early rulemaking process became rather adversarial should have been predictable. For example, the Safety Act passed by Congress in Sept. 1966, required that Initial Federal Motor Vehicle Safety Standards become effective no later than Jan. 1, 1968. So this allowed only fifteen months for the government to complete its rulemaking process and for vehicle manufactures to perform the mandatory engineering, certification, & production implementation process.

Fortunately, with the passing of time, the working relationship between truck manufacturers and the government improved immensely. Later in the presentation, I will cite some examples of the industry's pro-active leadership role that lead to this improved working environment. I have selected the 121 braking standard and the 208 crashworthiness standard as specific illustrative examples.

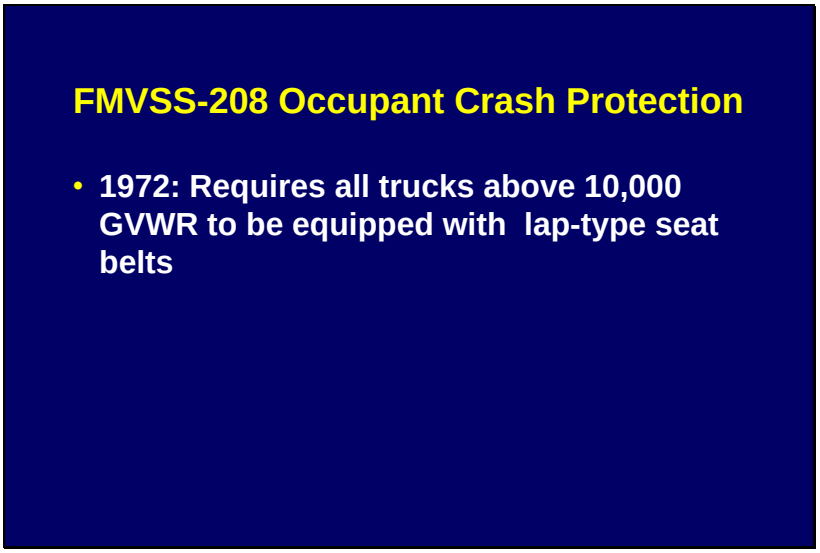
Slide 10



Following a very controversial and accelerated rulemaking process, MVSS-121 was implemented in March 1975 and was struck down by the 9th Circuit Court decision 3½ years later in October 1978. Revised braking performance requirements, as stipulated by the 9th Circuit remand, were finally re-instated by NHTSA in early 1997.

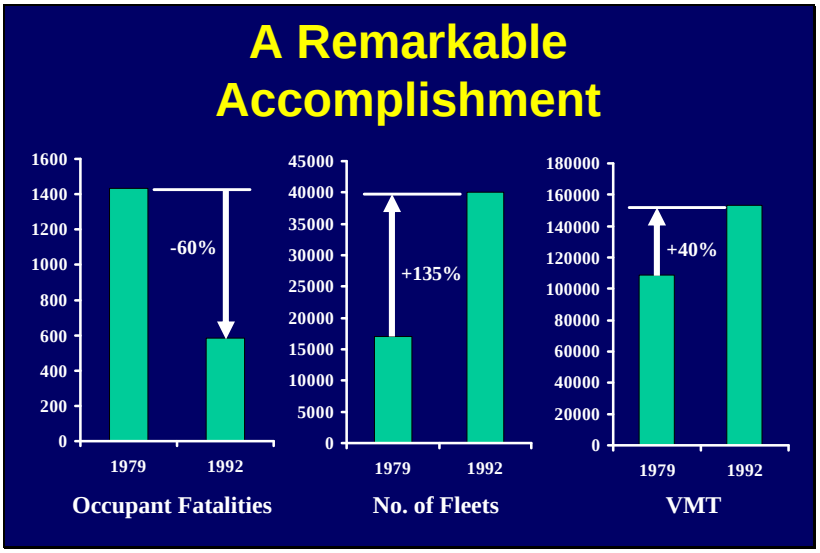
The moral of this unremarkable costly episode is as follows: the Nation's motoring public not only had to pay the initial upfront vehicle cost increase in 1975; but, for the next two decades, had to pay the additional societal cost incurred from an MVSS-121 braking regulation that was void of stopping performance requirements between 1978 and 1997.

Slide 11



In turning to this positive illustration, even though Standard 208 still only requires installation of lap belts, significant advancements have voluntarily been made by truck manufacturers to improve occupant crashworthiness. Results of these improvements are shown on the next slide.

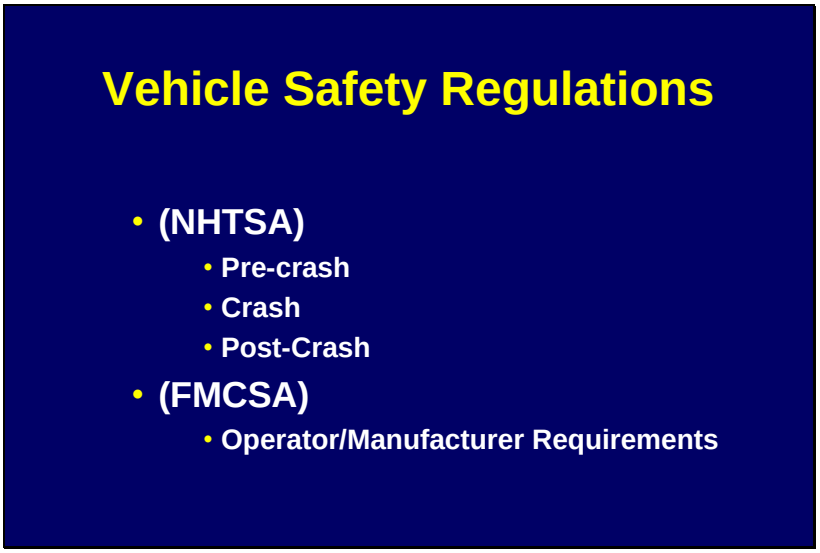
Slide 12



The U.S. experienced a 60% reduction in the annual number of truck occupant fatalities during the decade of the 80's; even though the number of licensed fleets increased by 135% and the annual truck vehicle miles traveled increased 40%. It seems to me that this remarkable accomplishment is one of the industry's "best kept secrets."

Later in the presentation, I will show you a more detailed breakdown of these fatality statistics, along with an overview of some of the voluntary programs that have been implemented to improve vehicle crashworthiness.

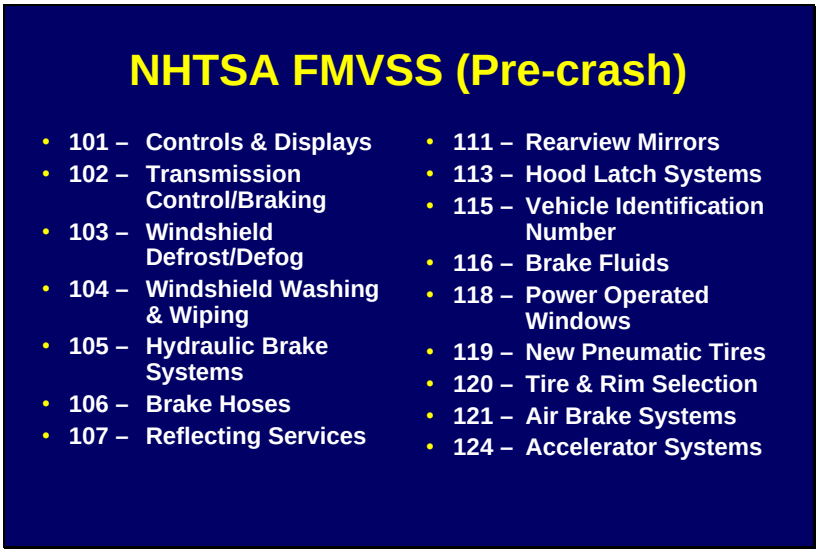
Slide 13



NHTSA Federal Motor Vehicle Safety Standards (FMVSS) fall into the three categories shown here. FMVSS are mandatory manufacturer requirements applicable to all new vehicles.

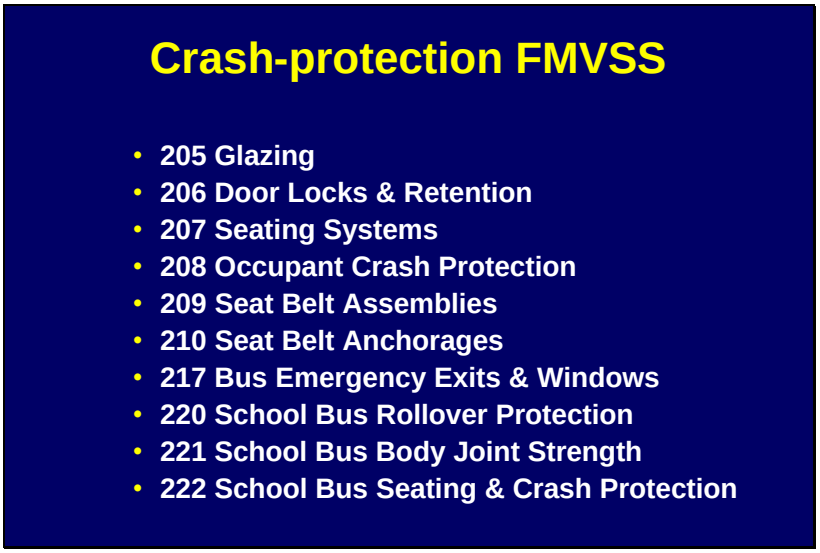
FMCSA regulations are classified as "operator" regulations but are in fact "defacto" design requirements for which the vehicle manufacturer assumes compliance responsibility.

Slide 14



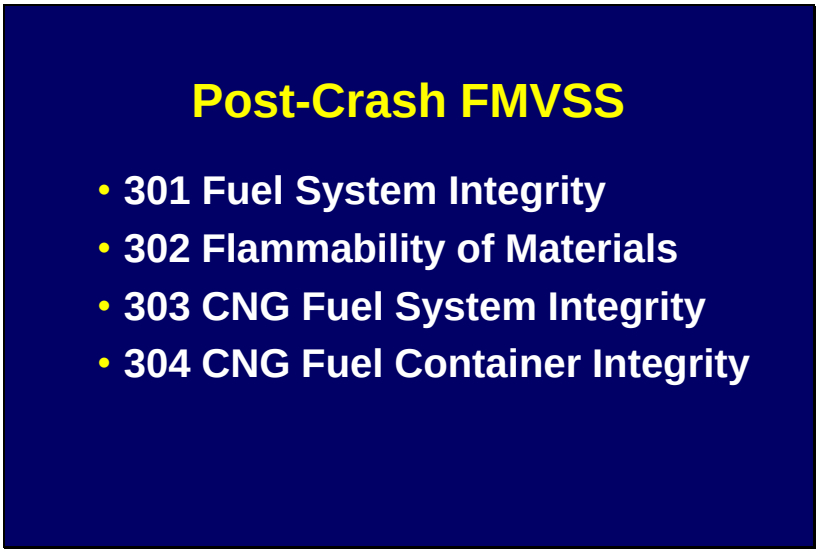
Here is a list of NHTSA's pre-crash standards that are applicable to medium/heavy trucks, including Standard 121 that I mentioned earlier.

Slide 15



Shown here are ten NHTSA crash-protection standards including Standard 208 that I mentioned earlier.

Slide 16

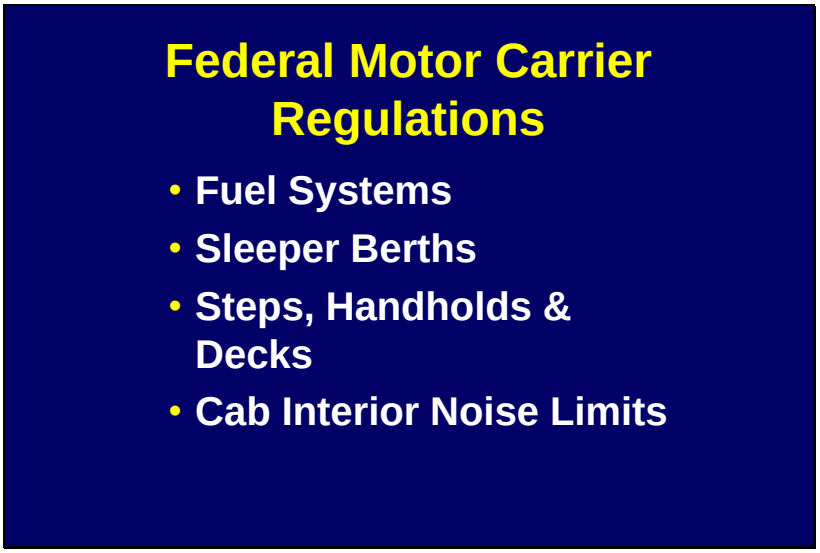


And here is a list of four post-crash Standards aimed at the mitigation of post-crash fire-related injuries.

Slide 17

And for good measure, here is an additional list of misc. regulations that are codified as CFR's under the Code of Federal Regulations. As an example, the last regulation on this list defines procedures and penalties for vehicle safety defects and non-compliance violations as stipulated in the 1966 Safety Act.

Slide 18



These are the motor carrier operator regulations that I alluded to earlier. Since these standards specify design requirements, they also become the vehicle manufacturer's responsibility.

In summing up the USDOT safety regulations that I have just reviewed, there are a total of 36 that apply directly to vehicle manufacturers. Mandatory compliance with these regulations impose a significant impact on vehicle design, testing and development, engineering certification, and manufacturing.

Slide 19

I will conclude this portion of my presentation by briefly reviewing three examples of International's commitment to product safety. The first example occurred in the late 1960's, the second one in the late 1970's and the third one in the late 1980's.

In the late 1960's International introduced completely redesigned versions of both its Scout and Light-line Models. Even though many of the passenger car safety standards were not applicable to light trucks and multi-purpose passenger vehicles, International Corporation voluntarily incorporated most of the passenger car safety features as standard equipment with the initial production of the Scout and Light-line models.

Slide 20

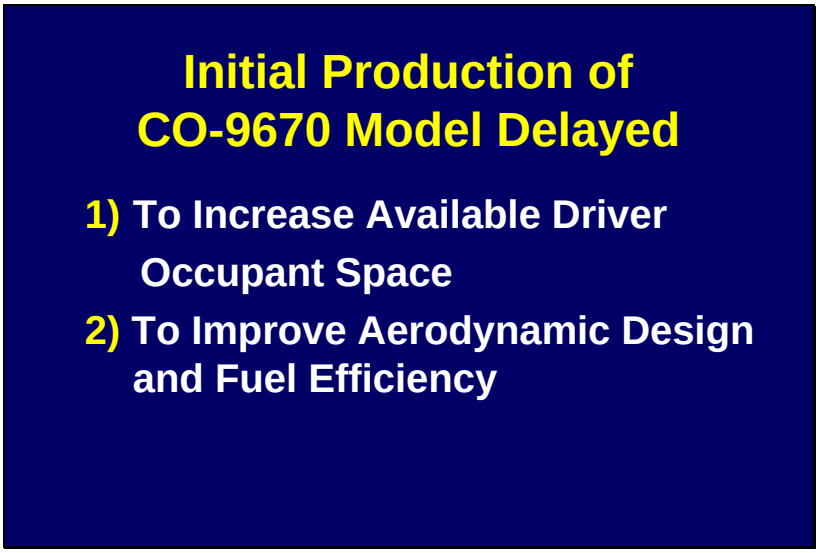
Shown here are the effective dates at which time NHTSA extended the applicability of these passenger car standards to the International Scout and Light-Line models. It is noteworthy that none of these Standards became applicable to the Light-Line during its five-year life span from 1969 thru 1974. Likewise, three of the key crashworthiness standards did not become applicable to Scout-type vehicles until after the Scout Model was phased out of production in 1980.

In the final analysis, it is rewarding to know that the competitive cost penalty incurred by International was offset by tangible consumer benefits. Results of in-depth crash investigations revealed that the enhanced safety features incorporated into the design of these two International product lines produced a meaningful-competitive-advantage in terms of mitigating the number and severity of occupant crash injuries.

Slide 21

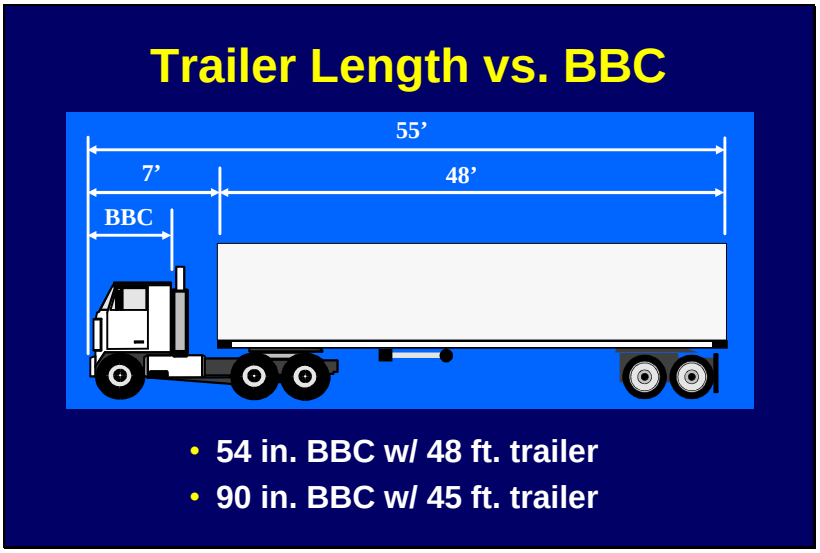
Initial production of the Co-9670 model originally scheduled for the late 1970's was delayed until 1981 to permit redesigning the vehicle to address a couple of pertinent emerging issues.

Slide 22



The reason for the redesign program was two-fold: No. 1) to provide additional driver occupant space by increasing the BBC (bumper to back of cab) dimension; and No. 2) to improve the aerodynamic design and fuel efficiency of the vehicle.

Slide 23



55 foot overall length laws were prevalent in the 1960’s and 70’s. To tow a 48 ft. trailer required the use of a HET COE with a maximum BBC of 54 inches to accommodate a minimum 30-inch trailer gap. The CO-9670 redesign increased the minimum BBC of the non-sleeper model from the traditional 54 inches to 63 inches to provide the driver an additional 9 inches of ”belly room.”

Increasing the cab length also allowed modifying the frontal contour of the cab to reduce aerodynamic drag.

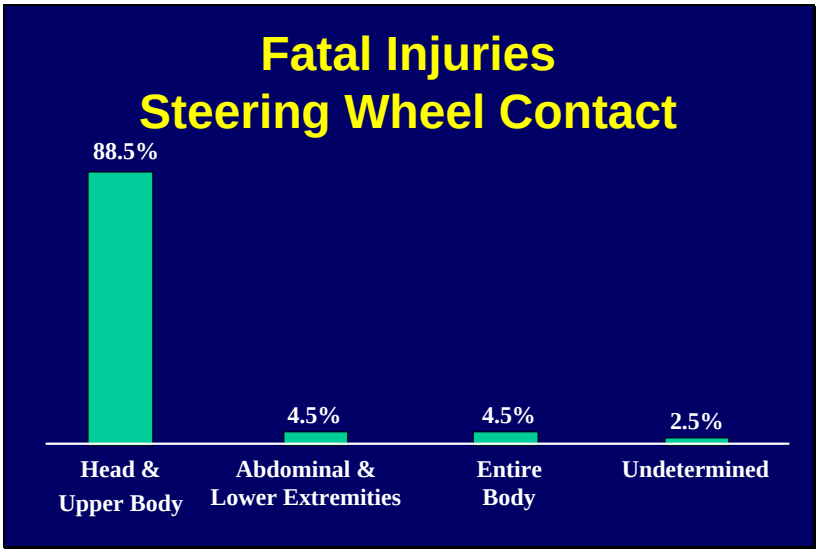
Slide 24

Examples of International's Commitment to Vehicle Safety

- Voluntary Adoption of Pass. Car Safety Standards in Scout & Light-Line
- Pre-Production Redesign of CO-9670
- **Installation of 3-Point Restraint Systems as Standard Equipment on all Models**

As mentioned earlier, when 2-point lap belts became standard in heavy trucks for the first time in 1972, there was a general belief that abdominal injuries were the most prevalent steering-wheel-induced injuries that occurred in frontal crashes; and, therefore, the lap-belt restraint provided adequate injury protection for the driver.

Slide 25



However; International's statistical analysis of 1986 driver injury data published by the University of Michigan revealed that abdominal injuries account for less that 5% of steering wheel injuries, while injuries to the head and upper body account for nearly 90% of the fatal injuries.

Thus, it was concluded that three-point shoulder-belt restraint systems would serve as an effective countermeasure in reducing the high incidence of head and upper body injuries. On the basis of this new finding, three point restraint systems were released as standard equipment on all International Models.

Slide 26

Having covered the topics of enabling legislation, gov't regulation, and International's commitment to "corporate citizenship", I will use the remainder of my allotted time to overview the pro-active leadership role launched by truck manufacturers in the late 1960's via the Automobile Manufacturers Association (AMA).

AMA was reorganized in 1972 as the Motor Vehicle Manufacturers Association to better serve the special needs of heavy truck manufacturers. This initiative lead to a much improved co-operative and productive working relationship with the U.S. DOT to collectively address numerous real-world safety issues.

Slide 27

As a reference for additional information on many of the programs that are identified in the following slides, I would refer the audience to this SAE Paper that was presented during the November 1993 SAE Truck & Bus Meeting. The title of the paper is "<u>The Decade of Declining Heavy Truck Fatalities…A Tribute to the Cooperative Process.</u>"

Slide 28

Even though the accelerated rulemaking schedule set forth by the 1966 Safety Act did not allow time to do necessary problem-identification research studies, truck manufactures took the early initiative of developing and sponsoring a long-range research program.

Truck manufacturers collectively funded this 25-year effort under the auspices of the Motor Truck Manufacturers Division of the Motor Vehicle Manufacturers Association. The planning and monitoring of this research effort was carried out by the MVMA Motor Truck Research Committee, on which I had the pleasure of representing International during this 25 year period, serving as chairman of the committee for nine of the 25 years.

Slide 29

This is an alphabetical listing of the kinds of research studies that were funded by truck manufacturers thru the MVMA. I will summarize briefly the three underlined topics, beginning with Truck Ride Quality.

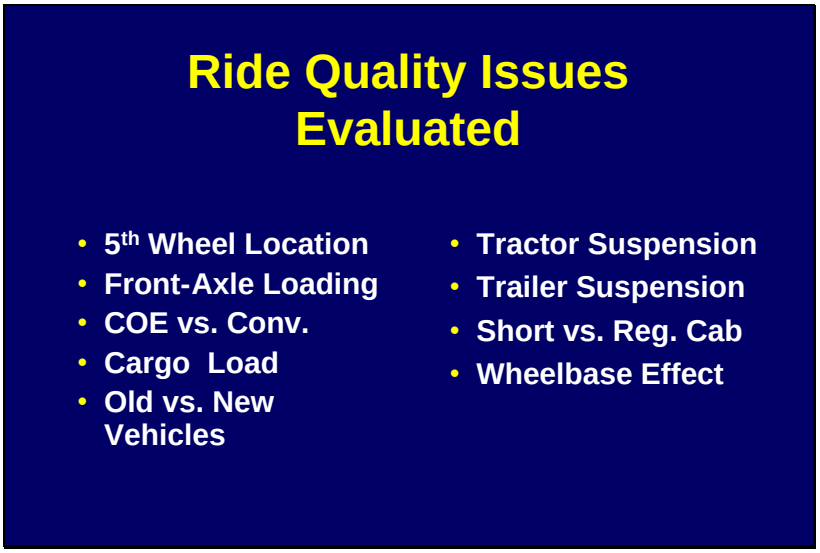
However; before leaving this slide I think it is important to mention that the results of many of these research studies, that I do not have time to discuss, were utilized by vehicle manufacturers to improve vehicle design and operational performance.

Slide 30

Truck ride quality, as it relates to driver fatigue and general health effects, became a priority safety issue in the mid-70's. As a way of objectively addressing the many ride-quality allegations being espoused by numerous individuals and organizations, MVMA sponsored this Detroit-to-Mackinaw ride demonstration.

Eight matched pairs of tractor-trailer units were employed to address a number of sensitive ride-related issues. Fifteen key individuals from industry and government participated in the demonstration as passenger-seat observers.

Slide 31



Shown here are the vehicle related technical issues that comprised the list of major allegations being evaluated as part of this demonstration. The results of this activity were quite effective in producing a quality technical analysis, as well as a better overall perception and understanding of the identified issues.

I think it is fair to say that the "going in" position of some of the participants ranged from having a perceived need to develop regulations for each of these areas, or perhaps even worse, to place operating restrictions on some of these vehicle attributes. Fortunately, in the final analysis, the USDOT's comprehensive June 1983 Report to Congress on Truck Ride Quality offered the following conclusion: "The general level of knowledge on the effects of vibration on driver health and highway safety cannot, without further research, support or preclude the need for Federal standards relative to vibration."

This 1983 DOT Report to congress, in conjunction with market-driven ride improvements developed by vehicle manufacturers, was effective in resolving the ride-quality issue.

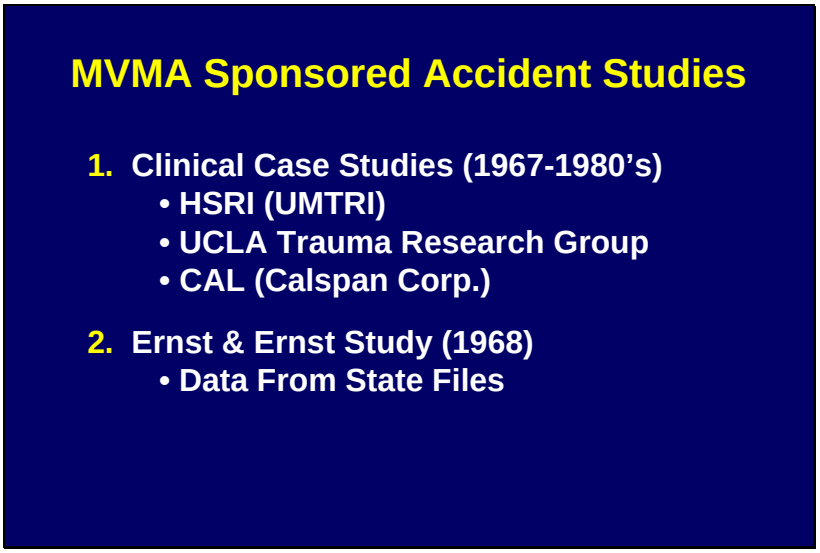
Slide 32

Shown here are two identically spec'd (except for paint color) tractors that International contributed to the ride-demonstration project. One tractor towed a loaded trailer and the other an empty trailer to demonstrate the effect of cargo loading on ride performance.

Slide 33

As rulemaking was being implemented under the 1966 Safety Act, truck manufacturers firmly believed it was important to have some level of understanding of real-world truck crashes. However; at that point in time no one, including the government, had a clue as to how many and what kinds of truck accidents were occurring in the U.S. In an attempt to acquire better data, truck manufacturers launched a productive long term program to acquire the necessary crash data.

Slide 34



The initial approach was to sponsor in-depth clinical case studies of a limited number of select truck crashes. These investigations were conducted by the Highway Safety Research Institute (which later became UMTRI), the UCLA Trama Research Group, and Cornell Aeronautical Lab (which later became Calspan).

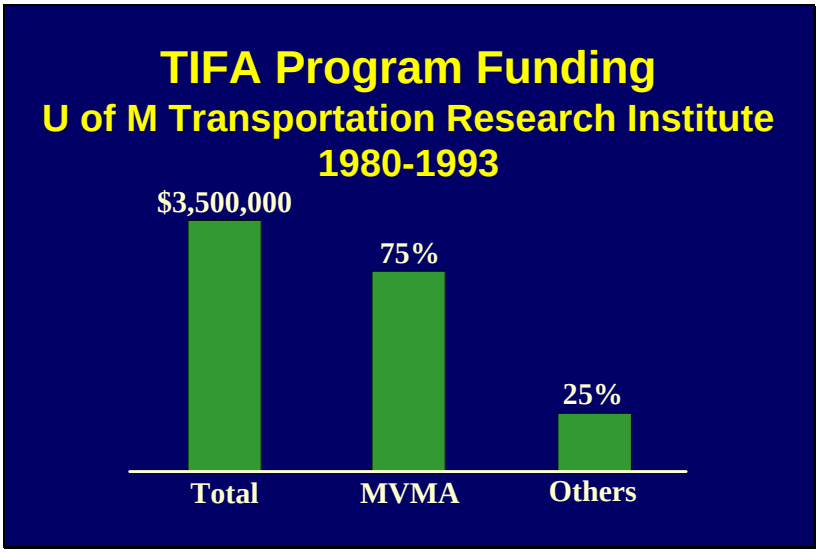
The follow-on Ernst & Ernst Study was initiated as an attempt to gain a better statistical understanding of truck crashes at the state and national level. The results of this 10-state study clearly revealed that the quality of state accident data files was extremely lacking.

Slide 35

As a third generation study, MVMA retained two leading independent research institutions, Calspan and Southwest Research, to analyze their respective crash data files in an effort to obtain information for responding to a highly critical report on truck safety published by the NHTSA'a National Motor Vehicle Safety Advisory Committee. The Calspan and Southwest Research analyses were unable to shed any light on the numerous safety allegations raised in the Advisory Committee's report. Later in the presentation, I will offer additional comment on MVMA's response to the Advisory's Committee's critical report.

As a fourth effort, in the late 1970's MVMA engaged the University of Michigan to develop and implement a heavy truck accident data program that would be responsive to the needs of truck manufacturers. This effort, which lead to the creation of a detailed census data base on all U.S. fatal truck crashes, became known as TIFA (Trucks Involved in Fatal Accidents). TIFA has evolved to become the premiere truck crash data program in the United States.

Slide 36



TIFA, which was initially totally funded by MVMA, later received partial funding from several other organizations including the USDOT. From 1980 to 1993, MVMA provided 75% of TIFA's 3 ½ million dollar operating budget. Although the USDOT is now the principal financial supporter of TIFA, the program is still being funded by International and one other truck manufacturer.

Slide 37

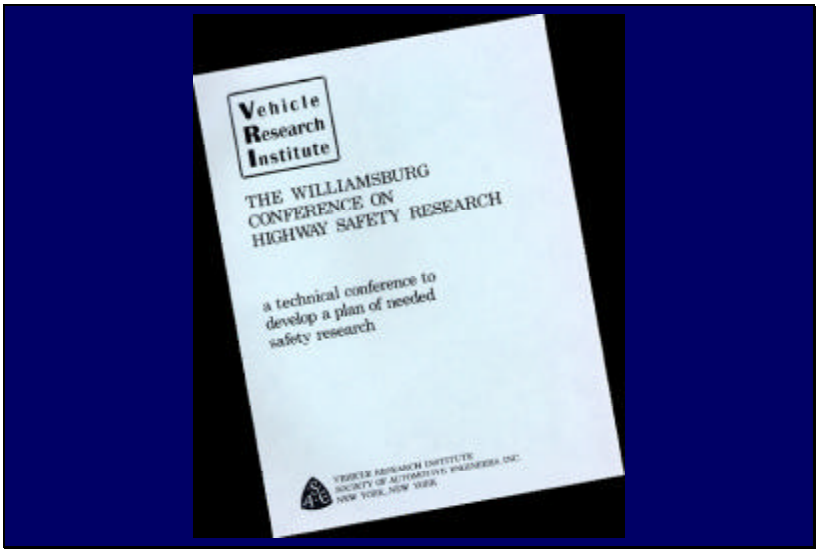
I would now like to take a few minutes to talk about how the trucking industry and the USDOT developed a close working relationship to collectively address key truck safety issues on a non-adversarial cooperative basis. This is a chronological listing of a representative sample of cooperative endeavors that took place over the span of a decade starting in 1972. To give you a synopsis of the process, I will highlight the four underlined initiatives. The first two items pertain to milestone planning conferences that were convened, and the last two represent significant bench-mark studies that are part of the crashworthiness success story that I mentioned earlier.

Slide 38

The stated objective of the 1972 Williamsburg 3-day high level government/industry conference with approx. 150 attendees was "to identify areas in which research is most needed and most likely to aid in the improvement of highway safety in the United States, and to recommend a responsive program of safety research to be under taken by the SAE's Vehicle Research Institute." Shown here are the eight research planning groups that were convened to develop research priorities for each of their respective areas of expertise.

The No. 7 Truck Group, of which yours truly was the designated chairman, developed a list of unique safety research needs for trucks, in addition to a research statement of truck needs relating to each of the other seven topics. International's Corporate Vice President of Engineering and the company's Manager of Engineering also participated in the 3-day conference.

Slide 39



There are a couple of good-news developments that accrued from the conference that were unfortunately offset somewhat by another one of those unremarkable post-conference bad-news developments. The first bit of good news is that the conference proceedings contained a comprehensive list of prioritized research programs that were to be jointly funded and conducted under the auspices of the recently formed SAE Vehicle Research Institute. The off-setting bad news is that a prominent consumer safety group filed a lawsuit against the Institute and was successful in winning a court injunction which prohibited the intended launch of the Institute.

The rest of the good-news story is that the complete list of Group-7 truck research needs identified at the conference have since been successfully completed; either by the trucking industry, or by the government, or as a cooperative government/industry effort.

Slide 40

In 1976, truck manufacturers took advantage of a second opportunity to promote the idea of working cooperatively with the government and other allied organizations. As I mentioned earlier, NHTSA's National Motor Vehicle Safety Advisory Committee had published a scathing report on truck safety; and that MVMA's analysis of the nation's best accident data sources was unable to confirm or refute most of the allegations contained in the Advisory Committee's Report.

Slide 42

MVMA's comprehensive report to the Advisory Committee, which was presented to the Advisory Committee in July 1976 by yours truly and Peter Griskivich of MVMA, offered this recommendation. To facilitate your reading, the highlighted portion of this recommendation is shown on the next slide.

Slide 43

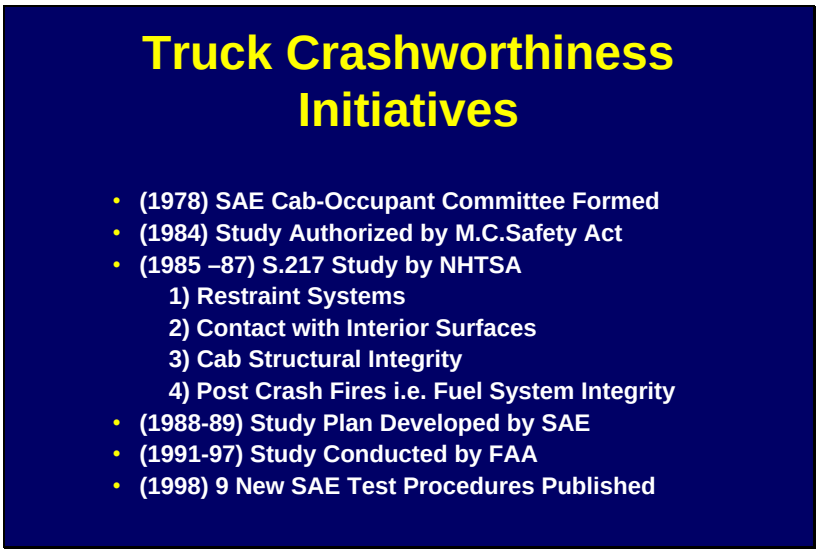
MVMA recommended "a coordinated heavy truck safety research and information gathering program involving government, industry, and the academic and scientific communities…development of better accident involvement reporting and evaluating procedures…and data on the effects of various vehicle designs…"

In retrospect, the Advisory Committee Symposium, which was initiated as a highly critical event, served as the launching pad for the highly successful gov't/industry co-operative programs that followed.

Slide 44

I will use the two highlighted studies shown on this slide as a lead-in to a discussion of the crashworthiness program to which I alluded earlier.

Slide 45



This slide outlines a 20-year chronology of key crashworthiness activities. In recognition of the rising number of truck occupant fatalities;, the SAE Cab-Occupant & Environment Committee was formed in 1978 to address, among other things, the crashworthiness issue. In response to a 1984 legislative mandate, Bill Leasure & Bob Clarke spearheaded the S.217 study by NHTSA. This first-of-a-kind Government/Industry study effort identified the four areas shown here as having the highest potential for further counter-measure development.

In 1988/89 the SAE Crashworthiness Subcommittee developed a study plan which led to a 6-year research program that was carried out by an organization known at that time as Failure Analysis Associates. Using the results of the FAA study, the SAE Crashworthiness Subcommittee has developed nine new test procedures for evaluating cab-crashworthiness performance.

Slide 46

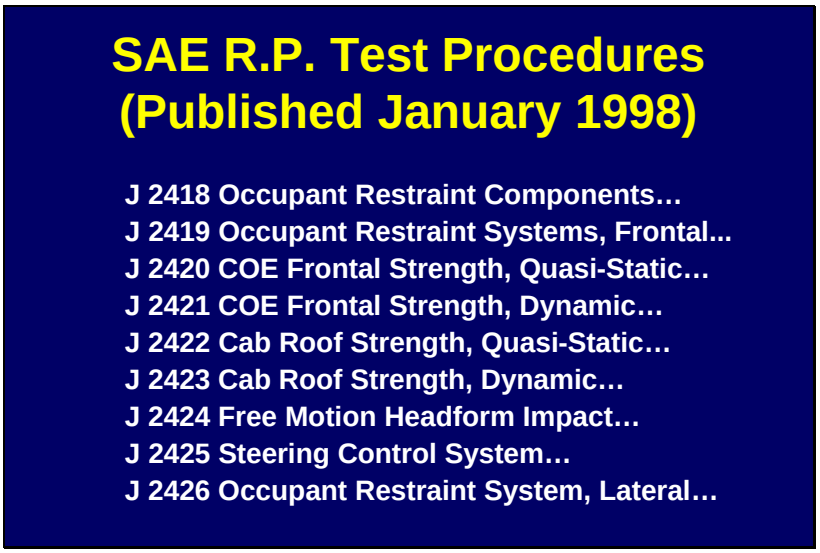
FAA Crashworthiness Study
(Co-sponsored by Gov't & Industry)

- Phase 1) Crash Data Analysis for Development of a "Crash Pulse"
- Phase 2) Finite-Element Model to Evaluate Cab Structure
- Phase 3) Test Procedures to Evaluate Cab Crash Performance

The first phase of the FAA Study was an extensive accident data analysis effort which resulted in the development of a crash pulse believed to representative of a so-called crash survivability threshold. In phase 2 a finite element model for evaluating cab structure was developed, and in phase 3 a considerable amount of crash testing was performed for the purpose of developing draft test procedures.

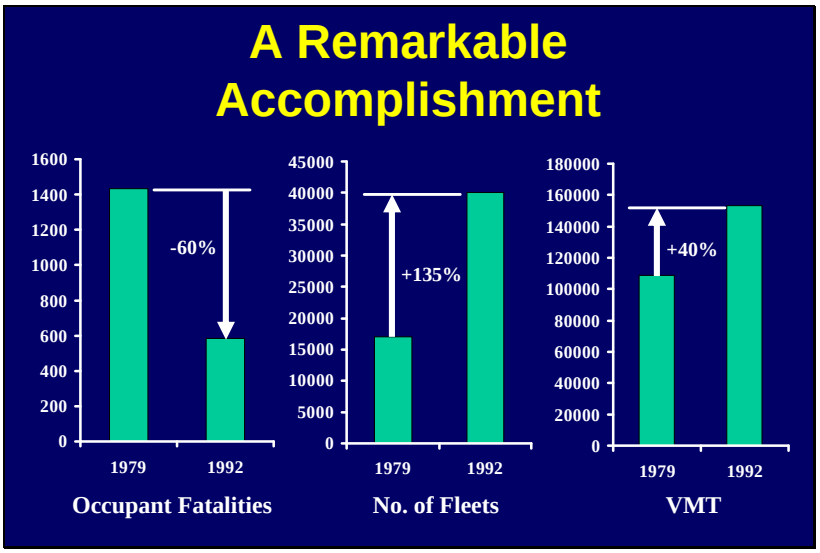
The funding and administration of the FAA project was carried out under the SAE Cooperative Research Program; which was finally implemented in the late 1980's as a means of carrying out jointly funded research as was originally intended by the SAE Vehicle Research Institute which I discussed earlier.

Slide 47



Shown here are the nine SAE Recommended Practice Test Procedures that resulted from the FAA Project. These procedures provide for both quasi-static and dynamic testing conditions.

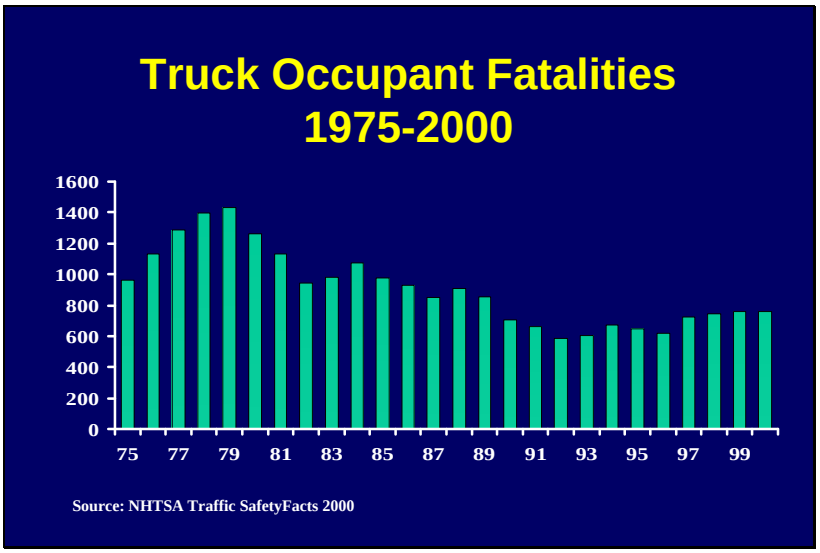
Slide 48



This is the same slide that I showed you earlier in the presentation. Now that I have shared with you "the rest of the story" on crashworthiness developments, I will show you the annual statistics on truck occupant fatalities from 1975 thru year 2000.

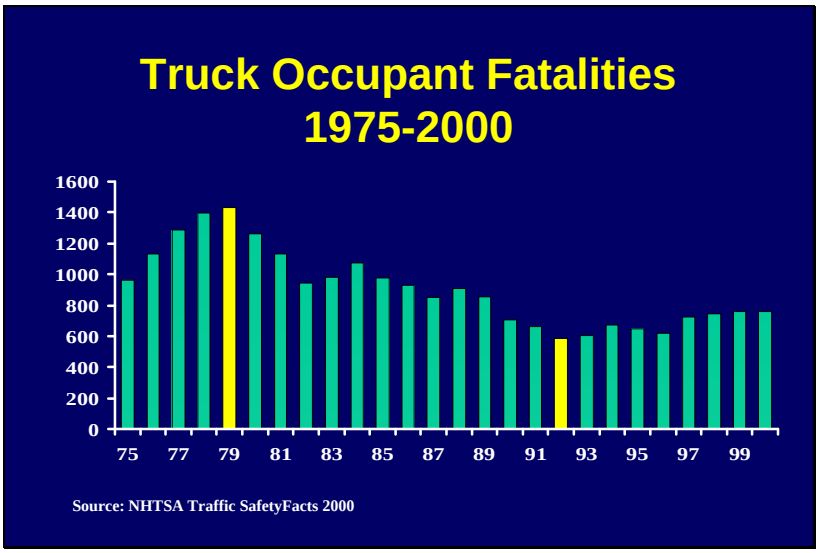
However, before doing that, I would like to reiterate a comment that I made in the early part of this presentation. Even though crashworthiness performance has improved dramatically, Standard No. 208 - which initially mandated the installation of lap belts in 1972 - has never been amended and is still in its original form.

Slide 49



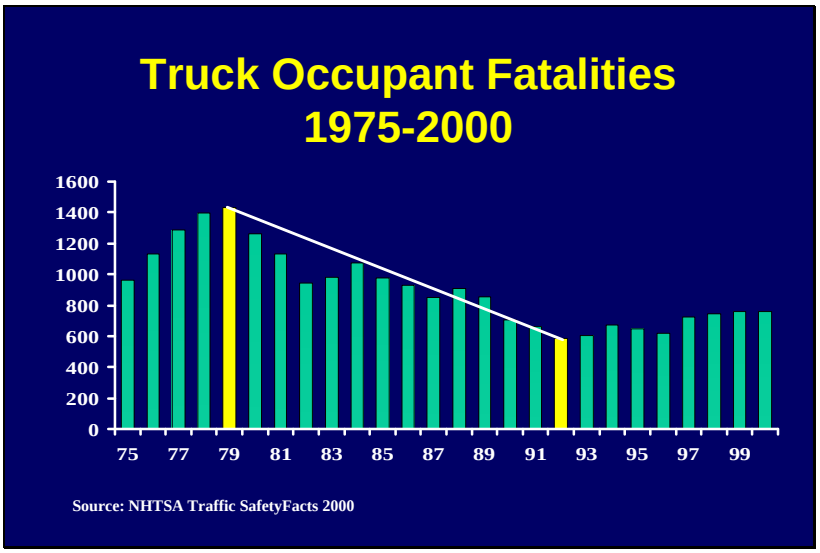
Shown here is the annual number of truck occupant fatalities from 1975 thru year 2000. In all fairness, when you see the rapid increase in the number of fatalities from 1975 to 1979, one can understand why emotions were running rampant at that time. This graph clearly shows a steady decline during the decade of the 80's, with a slight upward trend since that time. However, it is encouraging to note that the number of fatalities declined in year 2000.

Slide 50



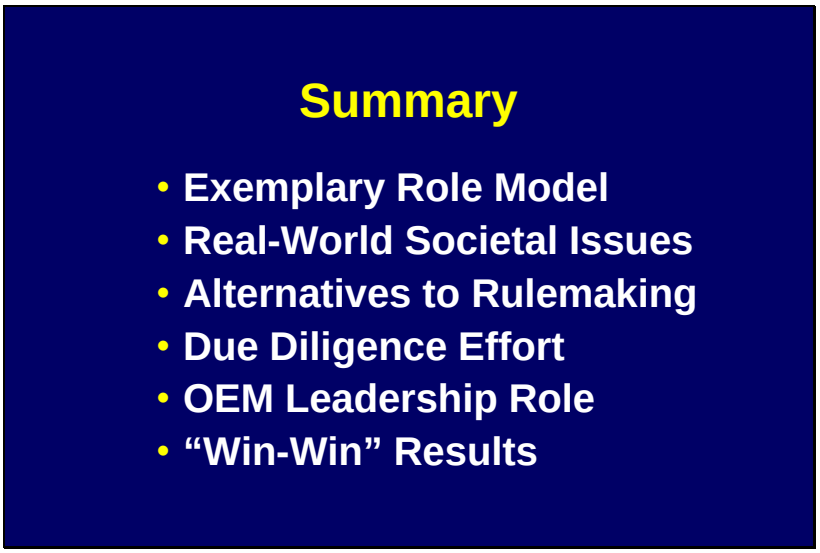
This same graph highlights the bench-mark years of 1979 and 1992 during which the 60% reduction in fatalities occurred.

Slide 51



And this is the same graph showing the slope of the curve from 1979 thru 1992; just to make the point that the number of fatalities for 10 years of this 13-year period are below that line.

Slide 52



In summary, I think it is abundantly clear that International and other U.S. truck manufactures have achieved the status of being an "exemplary role model" in responding to real-world societal issues. Truck manufacturers and the government have demonstrated that there are viable alternatives to rulemaking; and that the process does require due diligence on everyone's part. In my judgment, the historical record clearly shows that truck manufacturers have demonstrated a leadership role in advancing a non-adversarial cooperative working relationship between government and the private sector. In terms of payback to the industry, I firmly believe in the old adage that "you reap what you sow." We obviously will never know what the resulting consequences would have been if truck manufacturers had not launched the aggressive pro-active approach which I have attempted to overview in this presentation. However, the tangible benefits speak for themselves, and in my opinion, far outweigh the manufacturers' monetary investment. In closing, I would like to offer the following personal observation; the destination reached by International Corporation and the trucking industry at large, has made this pro-active journey an extremely gratifying experience for me. And I thank International for providing me that opportunity.