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FHWA Study Tour for Highway/Commercial Vehicle Interaction

U.S. Department of Transportation
Federal Highway Administration

EXECUTIVE SUMMARY

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FHWA's Scanning Program

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FHWA International Technology Scanning Program

Study Tour for

HIGHWAY/COMMERCIAL VEHICLE INTERACTION: NORTH AMERICA AND EUROPE

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EXECUTIVE SUMMARY

Introduction

Under the sponsorship of the Federal Highway Administration (FHWA), a team of representatives from government, industry and the research community made scanning trips through North America and Europe to discuss and report on current practices, technologies, and knowledge of the highway/commercial vehicle interaction. The North American trip was conducted in September–October 1994 and the resulting consolidated view of current issues surrounding trucks and highways was given increased perspective by the European trip, which took place in April–May 1995. Both trips included visits with government agencies, vehicle and component manufacturers, carriers, research agencies, and academe.

The studies were coordinated by the Transportation Technology Evaluation Center (TTEC) of Loyola College in Baltimore, Maryland, under contract to the Office of International Programs of the Federal Highway Administration. The delegations were led by Byron Lord, Chief, Highway Infrastructure Applications Division, FHWA Office of Technology Applications.

The North American trip included the United States, Canada and Mexico. A wide range of views were sought concerning the technical, regulatory, and policy issues surrounding highway freight transportation and the interaction between heavy vehicles and highway systems, including pavements and bridges. Particular emphasis was placed upon the influence of heavy vehicles on infrastructure wear and on highway safety.

Many of the issues discussed are critical to the formulation of policies for managing infrastructure preservation and development, controlling the size and weight of heavy vehicles, and improving the productivity and safety of highway freight vehicles. There are also important implications for intermodal freight systems.

The European trip included meetings in France, the United Kingdom, Belgium, the Netherlands, Germany, and Sweden. These meetings included representatives of national agencies, universities, and private companies, as well as the European Commission (EC) and the European Council of Ministers of Transport (ECMT).

Background

The United States, along with its trading partners, recognizes the economic significance of efficient highway transportation and is seeking improvements in highway freight productivity, more efficient national and regional intermodal transportation systems, the reduction of congestion, maintenance of mobility, preservation of the environment, the enhancement of the national economy, and the improvement of vehicle and highway safety. From an international perspective, more efficient means of the transportation of intermodal containers is of great significance, and the compatibility of truck sizes and weights takes on added importance under the North American Free Trade Agreement (NAFTA).

Highway freight vehicles have been the subject of considerable policy debate for some time, particularly as the demand for freight transportation has increased dramatically over the past 20 years. The serviceability of highway infrastructure, increasing highway maintenance bills, the impacts of heavy vehicles on roads and bridges, and truck safety are all issues that have attracted attention. The matter of trucks and roads has proven to be, and remains, a complex and politically sensitive subject.

Technologies for improving the physical interaction between trucks, pavements, and bridges, along with advances in freight logistics, intermodalism, and Intelligent Transportation Systems (ITS), can make a major contribution to meeting expanding demand for road travel and higher user expectations for highway quality under conditions of shrinking highway budgets. New knowledge and technologies relating to the highway/commercial vehicle interaction have a potentially important role in reevaluating alternative size and weight policies and vehicle configurations.

These issues lie at the interface of many industrial, governmental, and technological sectors. To make the review manageable, this report concentrates on factors and issues that could improve the productivity, safety, and external impacts of freight transportation.

Goals and Objectives

The overall objective of the Scanning Tour of North America and Europe was to **scan current practices, innovations, policies, rules, and compliance to identify options and issues in highway/commercial vehicle interaction technology.** The goals of the team included the following:

1. Building and strengthening the **state of mutual understanding among components of the transportation technology system**; i.e., road users, carriers and shippers, vehicle manufacturers, road builders, and regulatory agencies.

2. Assisting the **evolution of technology and policy initiatives, and benchmarking of current North American technology**.

3. Documenting information on both current practices in truck-pavement design and on new and emerging technologies that have potential for immediate or long-term application for **extended pavement and bridge life**, while allowing for **increased productivity** in terms of the amount of goods transported.

4. Evaluating specific vehicle, vehicle component, and pavement and bridge design effects on **highway infrastructure and vehicle life cycle costs.**

5. Identifying **trends in vehicle design, vehicle components, truck controls and regulations, and truck operational characteristics** in the context of their influences on pavements and bridges.

6. Identifying implications of vehicle and highway technologies and policy options with regard **to vehicle safety performance and highway safety.**

7. Promoting the development and **implementation of promising technology in the United States**.

Conclusions

The scanning team's report identifies a wide range of issues that influence the productivity, safety, and external impacts of the US freight transportation system. These issues involve national transportation policies; changing truck technology; the design and condition of the nation's pavements and bridges; the compatibility, optimization, and enforcement of size and weight limits; reducing user costs; more adequate recovery of infrastructure costs; further improvement of highway safety; exploitation of intermodalism and Intelligent Transportation Systems (ITS); and organizational factors that make it difficult to sufficiently assemble broad-based technical and policy input for legislative activity affecting freight transportation. The list below is an overview of the team's findings and conclusions, which are detailed in Sections 3 and 4.

1. Vehicle Configuration and Road Friendliness

The configurations and components of heavy vehicles are determined by existing constraints. These constraints include regulations (including size and weight), driver operational limitations, safety, and infrastructure design standards. The condition of the infrastructure can also cause changes to vehicle configurations. In every case, the laws of physics play a significant role in the options available to the designers and builders of heavy vehicles. Differences in these constraints (e.g., regulations; infrastructure condition; geometrics on regional, national, and international levels) also have significant potential impact on productivity and efficiency.

A high degree of inventiveness and creativity exists within the heavy vehicle industry, which is, seeking to advance the productivity and efficiency of the fleet. In addition to advances in vehicle configuration and components, efforts to optimize productivity address development of intermodal relationships, permitted and special-purpose vehicles, and regulatory exceptions. The result has been a myriad of vehicle configurations serving regional and national markets.

Truck design can contribute to reducing pavement and bridge wear for given weights of load. The use of suspensions that distribute the weight efficiently among axles in multiaxle groups and reduce dynamic loading is expected to reduce pavement wear. Air suspensions generally have superior performance characteristics, not only for reducing dynamic pavement loading but also for truck stability and control performance. However, truck suspensions can only be expected to perform well up to specific tolerable levels of road roughness.

New designs of tires that may improve vehicle handling and economy often cause higher pavement contact stresses. These tires, with smaller diameters, low profiles, and high inflation pressures, appear to be creating problems for road wear and lateral dynamic stability.

Further research is needed to quantify the effects of dynamic loading and its spatial repeatability on pavement wear, provide reliable means of assessing vehicles for road-friendliness, and better describe the tire/road interface.

While not entirely clear regarding the benefits of certain measures aimed at road friendliness, several countries have introduced such measures/incentives, through weight increases or fee reductions, in order to encourage innovative technological applications.

2. Global Competitiveness

Global trade and competitiveness have placed increased pressure on advancing transport efficiency and productivity. Containerized cargo has become particularly significant in intermodal transport, both for improved cargo security as well as opportunities for improved efficiency.

In Europe, vehicles involved in hauling containers in combined transport are permitted an increase in gross weight from 40 tonnes (88,100 lb) to 44 tonnes (96,900 lb). This concession, designed to promote intermodal transport, has been in place since the 1980s and has been retained in the most recent round of European Commission deliberations on size and weight limits.

3. Vehicle Performance Standards

A significant body of knowledge exists regarding vehicle performance, design, and configuration. This knowledge is quite advanced in its comprehension of the relevant variables, sciences, and effects; and offers significant opportunities to develop performance-based standards for heavy vehicles.

4. Enforcement

Levels of regulation and standards enforcement vary significantly among the countries visited. Enforcement or the lack of it significantly influences levels of compliance. While this may be intuitively obvious, it was made clear to the study team in both North America and Europe. ITS developments are likely to provide significant benefits in future heavy-vehicle permitting, monitoring, cost recovery, and enforcement.

5. Safety

Heavy vehicle safety continues to be a significant issue in every country visited. The need to quantify safety effects and causes continues to elude researchers and regulators. Accident-reporting systems do not contain sufficiently detailed, vehicle-specific information to isolate causes or to develop recommendations to prevent future occurrences. Additionally, the statistical infrequency of heavy vehicle accidents complicates this issue. In response to this problem, several countries are developing performance standards based on engineering standards to increase vehicular and infrastructure safety.

Size and weight limits have a profound effect on vehicle configuration and, hence, engineering performance. Vehicle engineering performance, exposure, and size have a pervasive but indirect influence on safety. Because this effect is interactive, it is difficult to isolate it with accident data.

Determination of this effect is also made more difficult by drivers' efforts to compensate for poor vehicle performance.

While larger and heavier vehicles are not necessarily less safe, it is vital that appropriate engineering performance standards continue to be met and that the better-performing vehicle configurations are encouraged.

Research is needed to achieve the following results:

- Determine clearer correlations between engineering performance of heavy vehicles and accident risks.
- Determine appropriate performance standards to apply to various classes of heavy vehicles.
- Develop improved accident databases to identify the engineering characteristics of trucks involved in crashes.
- Develop and implement innovative means of improving safety through truck design, including measures to improve both active and passive safety.

6. Comprehensive Freight Policy

A comprehensive national freight policy was recognized by the panel as essential to the development of integrated multi/intermodal transport efficiency. It was recognized there was a general lack of national freight policy direction in nearly every country visited. Effective truck size and weight policy cannot be developed outside the context of national freight policy.

7. Infrastructure Investment and Cost Recovery

Improved highway design and maintenance standards can contribute to reducing truck user costs and to improving productivity. Pavements designed and maintained to interface with the new generation of vehicle technology developments would allow the potential economic and performance benefits to be realized. Stronger, smoother pavements can lead to improved highway/commercial vehicle interaction.

Across the spectrum of the countries visited, a need for significant additional investment in highway infrastructure was identified. These investments were projected to meet the need to preserve and restore existing facilities, as well as to expand facilities to provide access to intermodal and other key links. In every case the resources needed exceeded the revenue streams currently available. The economic and financial benefits of increased transport productivity can be substantial; however, it is necessary to formulate fair and equitable cost-recovery mechanisms to sustained infrastructure service.

Panel Recommendations

The panel developed and prioritized recommendations based on findings and conclusions from both the North American and European scanning tours. The recommendations are presented in three categories: high-priority items to immediately advance toward implementation; medium-priority recommendations that should be further pursued in the intermediate term; lower-priority, but important, recommendations that deserve further study or research.

The following are high-priority recommendations of the Highway/Commercial Vehicle Interaction Panel:

1. Technologies for Transfer to The United States

The following technologies are recommended for evaluation for transfer to the United States and consideration for future implementation.

Distill conclusions on the viability of "road-friendly" truck components for implementation in United States size and weight regulations with particular focus on the following components:

- Review suspension systems (particularly air suspensions or equivalent) for truck and infrastructure friendliness. Evaluate benefits and limitations for US application and appropriate implementation mechanisms.

- Evaluate the advantages and disadvantages of wide, single-based tires for heavy trucks.

- Consider implementation of load sensitive, automatically deploying lift axles to replace existing manual lift axles (consider phaseout of existing lift axles).

2. Expanded Leadership

FHWA and AASHTO (American Association of State Highway Transportation Officials), as regulators and operators of highway infrastructure, should provide the national leadership necessary to make the freight transport system more efficient, including the development of a continuing, cooperative working relationship with public and private stakeholders to address inefficiencies in the nation's freight transportation system and to promote appropriate solutions.

3. Comprehensive Freight Policy

Develop a comprehensive national freight policy that includes the following factors:

- Safety.
- Infrastructure.
- Modal efficiency.

- Truck size and weight policy.
- Taxation.
- Intermodal movement (especially containers).
- International competitiveness.
- Environment.

As part of current Federal efforts and in cooperation with customers and stake-holders, any size and weight changes should be accompanied by provisions for the following:

- Bridge stress, pavement, and capacity consumption.
- Vehicle performance (including tire parameters).
- Safety enhancements.
- Cost recovery by permit to agencies incurring costs.
- Elimination of ratcheting.
- Access control by States.
- Interstate/international compatibility (including better LCVs).
- Rationalization of fee structures, including permit fees reflecting intensity and extent of use.
- Controlled rail diversion.

The following medium-priority recommendations are supported for consideration in the intermediate term:

4. Performance Standards

A performance-standards approach to size and weight regulations should be seriously considered. Performance standards should address acceptable vehicle operations and include consideration of safety and infrastructure impacts. Highway performance standards related to pavement design and rehabilitation should consider a truck-related pavement condition index and tire parameters. Implementation feasibility should be reviewed including institutional factors.

5. Cost Recovery

Existing cost allocation procedures for trucks should be benchmarked, and a rational procedure for cost recovery under any revised size and weight limits should be established. Appropriate charges for the operation of high-productivity vehicles should be established. States should have a size and weight permit review process to assess impacts on pavements and bridges and should assure appropriate cost recovery to the agencies incurring the costs.

6. Possible Short-Term Changes to Accommodate Intermodal Containers

In the interest of international compatibility of intermodal containers, consideration should be given to a specific change of US size and weight regulations for containers on tridem axle semitrailers, at appropriate gross vehicle weight (GVW) above 80,000 lbs.

7. Re-assessment of Bridge Formula

Existing Bridge Formula "B" should be reassessed with the intention of providing a more appropriate control on bridge stress, if possible. Any proposed change in truck size and weight limits should be screened to ensure compatibility with an appropriate bridge formula, the ratings of existing bridges, and bridge design standards.

8. Envelope of Allowable Vehicle Configurations

If performance standards appear feasible, policymakers should consider development of envelopes of allowable vehicle configurations for designated systems and subsystems, based on engineering and safety performance of both vehicles and infrastructure.

9. Enhanced Truck Accident Data

A national system should be developed to identify and evaluate all accidents involving large trucks. Such a system should include an improved accident/VMT (vehicle miles traveled) recording system sensitive to vehicle type, configuration, and design.

The following lower-priority but important recommendations are also supported for further study and research:

10. Researching "Road-Friendly" Vehicles

Truck and infrastructure research should be expanded to resolve questions concerning the extent of potential benefits to pavements and bridges of "road-friendly" vehicles.

The possibility of differential weight limits or fee schedules for "road-friendly" suspensions should be further explored. The issue of the maintenance of "road-friendly" suspensions should be further explored, especially the means of ensuring the maintenance of damping characteristics over time.

11. More Effective Enforcement

More effective deterrence from overloading should be provided in enforcement programs. The programs should include the factors listed below.

- An escalating fine structure with stiffer penalties for greater degrees of overload and repeat offenders.

- Education of judicial branches at all levels concerning the consequences of overloading for the infrastructure.
- Effective judicial enforcement.
- Application of ITS technology.

12. Standards for International Containers

More effective means of establishing and maintaining standards for the size and weight of international containers should be explored.

13. Public Education

A public education program should be developed to address heavy vehicle size and weight issues, particularly with respect to safety, intermodalism, and environmental issues.