# RESEARCH PAYS OFF

# Public/Private Partnership Beneficial for Truck Research


A consortium of government agencies and businesses in Canada began research a decade ago to find ways to reduce infrastructure damage, increase safety, and gain productivity in trucking. Today, evidence of their success is beginning to accumulate.

## Problem

Truck size and weight regulations in Canada are the responsibility of the ten provinces and two territories. Conflicting rules and lack of uniformity have historically impeded the efficiency of the interprovincial highway transport system. These problems became more visible through the late 1960s and early 1970s as jurisdictions adopted differing approaches to improving highway system productivity and as new, more liberal means of assessing bridge capacity were developed.

By the early 1980s it was acknowledged that regulatory conflicts had become a serious impediment to interprovincial trade and a concerted effort was launched to improve the uniformity of truck size and weight regulations.

## Solution

The differences that arose in size and weight regulation reflected different engineering judgments about the structural capacity of highway infrastructure, the compatibility of large and heavy truck configurations with highway geometry, and safety concerns for truck performance as weights or dimensions change. To provide a common technical basis for discussion of harmonization of regulations, it was agreed that research was needed.

The research approached the issues of vehicle weights and dimensions from a "first principles" perspective, focusing on identifying the type and magnitude of impacts that changes in truck size and weight parameters would have. Initial studies conducted on bridge capacity concluded that higher capacity existed than previously thought and that variations in the load-carrying capacity of different pavement structures used across Canada were likely to be a greater constraining factor.

To explore the remaining range of concerns, the largest highway research program ever undertaken in Canada was developed and launched. A nonprofit corporation, Canroad Transportation Research Corporation, was established to assemble the required $3 million funding from governments and industry and to organize the research. The Roads and Transportation Association of Canada (predecessor of today's Transportation Association of Canada) provided overall policy supervision.

During a 24-month period from 1984 to 1986, an exhaustive analysis was conducted of the sensitivity of vehicle stability and performance to changes in parameters including vehicle types, loads, axle spacings, suspension types, trailer lengths, and hitch types. Computer simulation models developed by the University of Michigan Transportation Research Institute allowed the performance of more than 200 variations in truck configurations to be evaluated. The simulation results were validated and supplemented by stability and control tests carried out at test tracks in Canada and Michigan.

Pavement strain and deflection data were collected at 13 sites on the primary highway system across Canada under a common test program comprising a wide range of axle loads and configurations. In support of the discussion of regulatory harmonization, companion studies were undertaken on the impact of vehicle length on passing on two-lane highways, and on the economic implications of changes in size and weight.

## Application

The research results were used to support the development of national standards for truck size and weight regulations across Canada. The vehicle stability and control research resulted in the development of target minimum or maximum performance criteria for heavy truck characteristics in the areas of rollover, braking, turning, and dynamic stability. These criteria assisted in establishing weight and dimension limits for different configurations on the basis of their inherent stability and control characteristics. The pavement research produced a new understanding of load equivalency factors, on the basis of response character-

istics of pavement designs used in different regions of the country.

A national agreement based on the research findings was adopted by all provinces and territories in 1988. The provinces and territories agreed to adopt regulations that would allow nationwide use of vehicles meeting standard specifications for each of the four most common types of heavy vehicle configuration. In 1991 this agreement was expanded to include four additional vehicle configurations.

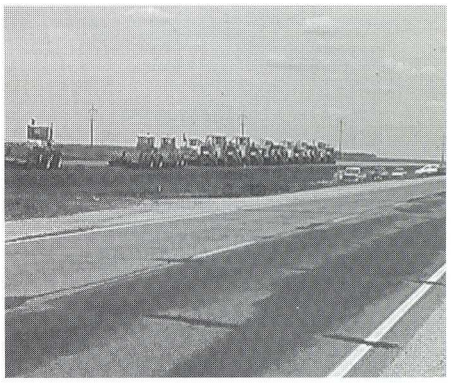
The research findings have assisted government and industry in understanding the costs, benefits, and implications of different approaches to improving the productivity of the highway transport fleet. As examples, the program demonstrated that

- Closing the spacing between axles in a tandem axle group (a pair of closely spaced axles) or tridem axle group (three closely spaced axles) improves vehicle performance without increasing the impact on pavement;
- Use of liftable axles is detrimental to vehicle performance and to pavements;
- Double and triple trailer combination performance improves substantially if the so-called B-train configuration is used (in which the second trailer is coupled to a fifth wheel mounted on the rear of the frame of the front trailer) or the trailers are coupled by means of a double-drawbar converter dolly, compared with performance using the single-drawbar converter dolly; and
- Use of longer trailers and tractors improves stability and control.

## Benefits

Harmonization of truck size and weight limits has resulted in improved highway system productivity; regulatory incentives to use the most stable, safest, and most productive vehicle configurations; reduced impacts on highway infrastructure; and reduced transportation costs. For the future, the research has produced a sound, performance-based foundation to guide the evolution of truck size and weight limits.

The economic impact assessment studies predicted that, as a result of the changes that were introduced, the net annual savings would be about $180 to $300 million. As implementation of the findings is now five years old, a follow-up study was recently commissioned to assess the validity of these economic impact predictions.



Pavement instrumented with strain gauges and deflection-measuring devices was used for testing effects on pavement of alternative configurations.

Although the quantitative evaluation is not yet complete, observations indicate that the new regulations have induced a substantial shift of traffic from 6-or-more axle tractor-semitrailers and from doubles using single-drawbar dollies to B-train double trailer combinations. The research demonstrated that the B-trains are more stable than the vehicles they are replacing, and have better turning performance than the tractor-semitrailers replaced, so safety benefits and reduced traffic interference can be expected. The new vehicles cause only half the pavement wear per ton of payload, and are more productive for motor carriers compared with the tractor-semitrailers replaced.

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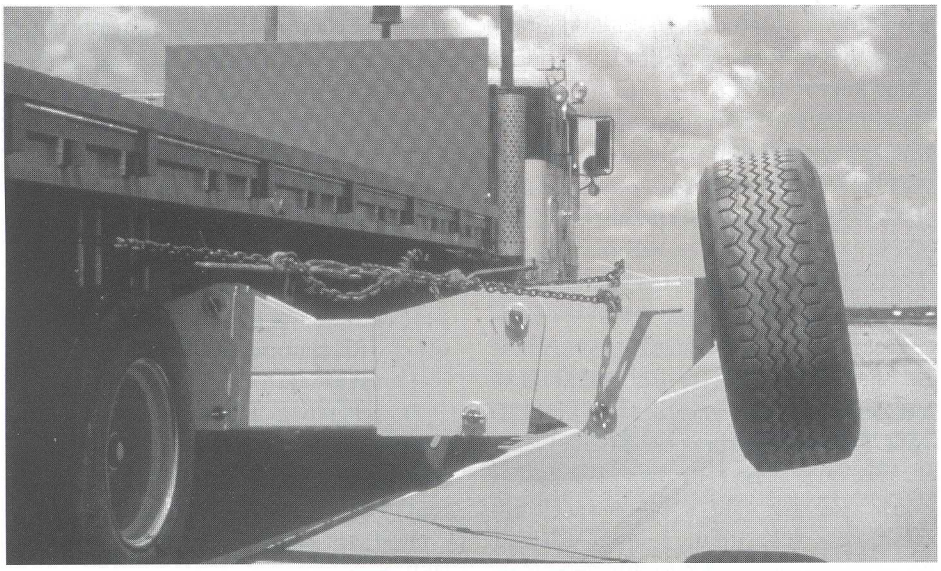

Outrigger mounted on flatbed semitrailer to prevent rollover during stability testing of truck configurations by Ontario Ministry of Transportation.

Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2952).