CONCEPTUAL FRAMEWORK FOR A PERFORMANCE-BASED OVERSIZE AND OVERWEIGHT PERMITTING SYSTEM

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ABSTRACT

This paper presents a conceptual framework for a federally supervised, state-administered, performance-based oversize and overweight permit program for the operation of heavier and larger vehicles on the public highways. The structure of the permitting system is based on experiences and practices in implementing performance-based systems in Australia, Canada, New Zealand, and the United States. Conceptually, the framework consists of three main interrelated components: administrative, enforcement, and evaluation systems. The administrative system comprises several elements directed at establishing the requirements, standards, and administration of the permitting system. The enforcement system includes regulations, special conditions, education or communication to the industry, effective fines or penalties for violators, and adjudication. The enforcement system will periodically generate records indicating carrier compliance or non-compliance with the terms and conditions of permits and the frequency of these events. The evaluation system defines the data and processes to ensure that the permitting system is continuously evaluated. The results of the evaluation are necessary for revising the performance standards, limits, and conditions for the permitted vehicles. The challenge is enforcement of the performance-based, oversize/overweight, permitting system. Periodic re-assessments of permitted vehicles in addition to continued roadside enforcement of operating conditions is recommended.

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1 INTRODUCTION

Truck size and weight (TS&W) regulations are important in determining infrastructure construction and maintenance requirements and the cost of freight transportation. All states regulate the sizes and weights of trucks operating on the public roads (USDOT, 2000). Federal and state TS&W regulations define the weight and dimensional envelope into which the truck fleet must fit, and this influences the characteristics of the national truck fleet. While federal law regulates truck size and weight, the states use a varied combination of weight limits. Only seven states apply the federal law directly without any modification or "grandfather right" adjustment. Several recent TS&W studies have generally included options to both increase and decrease Federal TS&W limits, and focused primarily on options to improve productivity through various increases in TS&W limits. The recent TRB Special Report 267, "*Regulation of Weights, Lengths, and Widths of Commercial Motor Vehicles,"* (TRB, 2002) provides policy-level recommendations designed to promote reform of the current federal regulations, as well as changes in the regulations to improve the efficiency of truck freight transportation and mitigate the cost of truck traffic to the public. The TRB study recommended that federal law should allow any state to participate in a federally supervised permit program for the operation of vehicles heavier than the present federal gross weight limit provided the state satisfies certain conditions. States will continue to implement their current permitting systems and after a transition period, all trucks operating under the grandfather exemptions or state-specific exemptions from federal regulations would be made subject to the requirements of the new permitting program. The report recommended a federally supervised permit program to rationalize the current state-issued exemptions. The permit program, implemented with federal oversight would be a mechanism whereby the performance of the regulations could be evaluated, and adjustment could be made when warranted by the evaluations and by changes in external conditions (TRB, 2002).

This paper presents a conceptual framework for a federally supervised, state-administered, performance-based permit program. The state-of-the practice in oversize and overweight (OS/OW) permitting in the United States and other countries including Australia, Canada, and New Zealand was assessed. The structure of the proposed permitting system is based on experiences and practices in implementing performance-based systems in Australia, Canada, New Zealand, and the United States. This paper is based on a research project completed for the Federal Highway Administration, U.S. Department of Transportation (Battelle, 2004). An expanded version of this paper was presented at the 2006 Transportation Research Board annual meeting in Washington, DC.

2 STATE-OF-THE PRACTICE IN PERMITTING IN THE UNITED STATES

Most heavier and longer combination trucks currently operate under some form of OS/OW permit system, and arguments have been made that the most promising approach to achieve improvements in motor carrier productivity, safety, and other goals is through substantially improved permit systems. States continue to control size and weight limits on state highways and Interstate highways under grandfather rights. Many states allow weight exemptions for divisible loads based on certain classes of vehicles or commodities, by statute or with permits. Significant variations exist among states in terms of policies and fees charged for vehicles that are above established size and weight limits. States participating in multi-state OS/OW permitting agreements have enabling legislations in place for non-divisible loads and would require legislative revisions for divisible load permits.

The structure and implementation of OS/OW permitting systems in the states are generally similar. For example, 31 states allow vehicles weighing more than 80,000 pounds to operate on the interstate highway system through grandfather rights or special statutory exemptions or under divisible-load permits. Most of the states make extensive use of their grandfather rights, increasingly through issuance of multiple-trip permits. Multiple-trip permits essentially allow unlimited operation with no accounting for mileage or routes for a greater length of time, generally one year (TRB, 2002).

Permit fees are usually set up to primarily recover the cost of administering the permit program and several states are in the process of revising the permit fee structures to include the cost responsibility of trucks into the pricing framework. However, full cost recovery is least likely to be implemented because permits are usually issued to promote local industries and thus it is difficult to charge permit fees that are commensurate with full cost recovery.

All states consider infrastructure-related performance measures in OS/OW permitting. The bridge formula and bridge analysis are the main infrastructure performance criteria used. With regards to safety-related performance, some states e.g., Idaho and Oregon apply special performance-related conditions or standards as part of the process used to determine the allowed routing and trailer combinations.

3 PERMITTING SYSTEMS IN OTHER COUNTRIES

Australia, New Zealand, and most provinces in Canada have used the performance-based system approach to investigate innovations in vehicle configuration and approve vehicles for operation under the permit regime (www.ntc.gov.au; http://www.ltsa.govt.nz/index-ltsa.html; Bruzsa and Hurnall, 1996; TAC, 1988). Although the approach in Australia and Canada is similar (there are significant variations from jurisdiction to jurisdiction because of differences in need), there appears to be a significant difference in emphasis between these two countries and New Zealand.

In Australia and most provinces in Canada, the performance-based system has been used to approve vehicles that are more productive and have performance characteristics that are better than the vehicles they replace. Thus, the main safety benefits arise from greater efficiency resulting in fewer trips and hence less exposure as well as some safety gains on individual

vehicles. In New Zealand, the focus has been much more on safety gains at the individual vehicle level rather than with substantial productivity improvements.

In some provinces in Canada, the concept of "envelops" of over-dimensional and overweight vehicles is used that depicts candidate requirements, conditions and restrictions for different widths, heights and lengths of vehicles and/or loads. Unlike the United States, certain enforcement rules apply with operation of special permits in some other countries. For example, Canada operates a revocable special permitting system where vehicles operating under special permits can be revoked for non-compliance with the terms and conditions of the permit. The revocable nature of this system serves an incentive to carriers to recognize the importance of maintaining good records. There is also close coordination between the regulating body and the carriers to develop and implement strategies that ensure safety and efficiency.

4 CONCEPTUAL FRAMEWORK FOR OS/OW PERMITTING SYSTEM

A good performance-based system must be both robust and simple enough to be practical and accommodate growth. A practical system is one that can be easily implemented and enforced. Implementation may require certification of vehicles stratified by type of configuration, commodity, and highways on which they operate. Practicality also can be defined in terms of ease of enforcement by roadside inspectors. This means that the system's performance measures or surrogate measures can be easily verified by conducting simple and quick tests at the roadside. It is also expected that there should be some level of regional flexibility in the methods of analysis in the performance-based system's pass/fail level criteria. However, the same criteria would be applicable to the same operating conditions regardless of the region or the country.

The following sections outline the essential elements of a performance-based system suitable for implementation in the United States. The performance-based permitting system comprises two major elements – the performance standards used and the framework of the system.

4.1 Performance Standards

Given that highway functional classes are designed to different geometric design standards, it is essential that any performance-based system be sensitive to functional road class (e.g., interstate, arterials, divided, non-divided). The geometric features have significant effects on the safety performance of vehicles. Thus, operational considerations are important when choosing a vehicle for special permit service. This means that vehicles that qualify for the special permit system must be constrained to designated routes defined by road class.

In order to achieve this required flexibility, it may be necessary to create variable performance criteria that are sensitive to the various factors. Performance standards can be grouped into two main categories: (i) safety-related performance measures and (ii) infrastructure preservation performance measures.

4.1.1 Safety Performance

The intrinsic safety performance of a particular vehicle under a specific TS&W limit is related to its engineering dynamic performance. This relationship is affected by external factors such as the operating environment. Certain dynamic performance measures appear to be more important than others in terms of their causal relationship to crashes. Some analyses have linked rollover

threshold, rearward amplification, braking efficiency, and low-speed offtracking to risks of certain classes of crashes. Of these measures, rollover threshold and load transfer ratio are the most meaningful. Rearward amplification is of great significance for multi-combination trucks and congested, high-speed traffic. Also, outboard offtracking response in a steady turn, and under transient conditions, is of importance for multi-combination vehicles.

4.1.2 Infrastructure Preservation

Bridge and pavement loading are the two primary infrastructure concerns of permitting OS/OW vehicles. Analysis of potential stresses imposed by a permitted vehicle provides an indication of the ability of the bridge structure to withstand the imposed loading. Similarly, analysis of potential pavement distresses resulting from repeated loading from OW vehicles provides indication of the performance of the infrastructure.

The notion linking infrastructure preservation to user/permit fees reflecting the cost of longer, heavier vehicles on the infrastructure is essential for accountability of the program. There is significant flexibility in how this can be accomplished and a national program will require a practical procedure. In Saskatchewan, Canada, the government calculates the increased profit that an overweight haul will produce and collects 50 percent of the increased profit from the carrier for infrastructure improvement on the particular haul route. In this system the carrier must prove that there is a significant economic benefit before it can be approved and must ensure that the vehicle complies with vehicle dynamic safety performance measures. Such complex systems may not be practical within a large-scale U.S. program. An example of a more realistic solution is graduated fees calculated on the basis of equivalent axle loads or extended vehicle dimensions possibly tied to offtracking that can be related to infrastructure use. In this way the costs to the infrastructure can be accounted for as part of the permit fee. It will be important to ensure that the fees collected for the permit system are retained by the road authority so that the funds can be invested into the infrastructure and the administrative costs of the permit system.

5 STRUCTURE OF PERMITTING SYSTEM FRAMEWORK

The conceptual framework of the permit system as illustrated in Figure 1 comprises three major systems or building blocks (administrative, enforcement, and evaluation). The components of each system are described in the following sections.

5.1 Administrative System

The administrative system comprises several elements directed at establishing the framework, requirements, and standards, as well as administration of the permitting system. Figure 2 illustrates the relationships among the components of the administrative system. The components are described in the following sections.

5.1.1 Legislative Framework

The legislative framework defines the roles, responsibilities, and authorities of federal, state, and other entities that would be involved in the permitting process. The relationship of the permitting system with existing multi-state agreements should be defined. Furthermore, the administrative procedures for appeal (due process) must be defined.

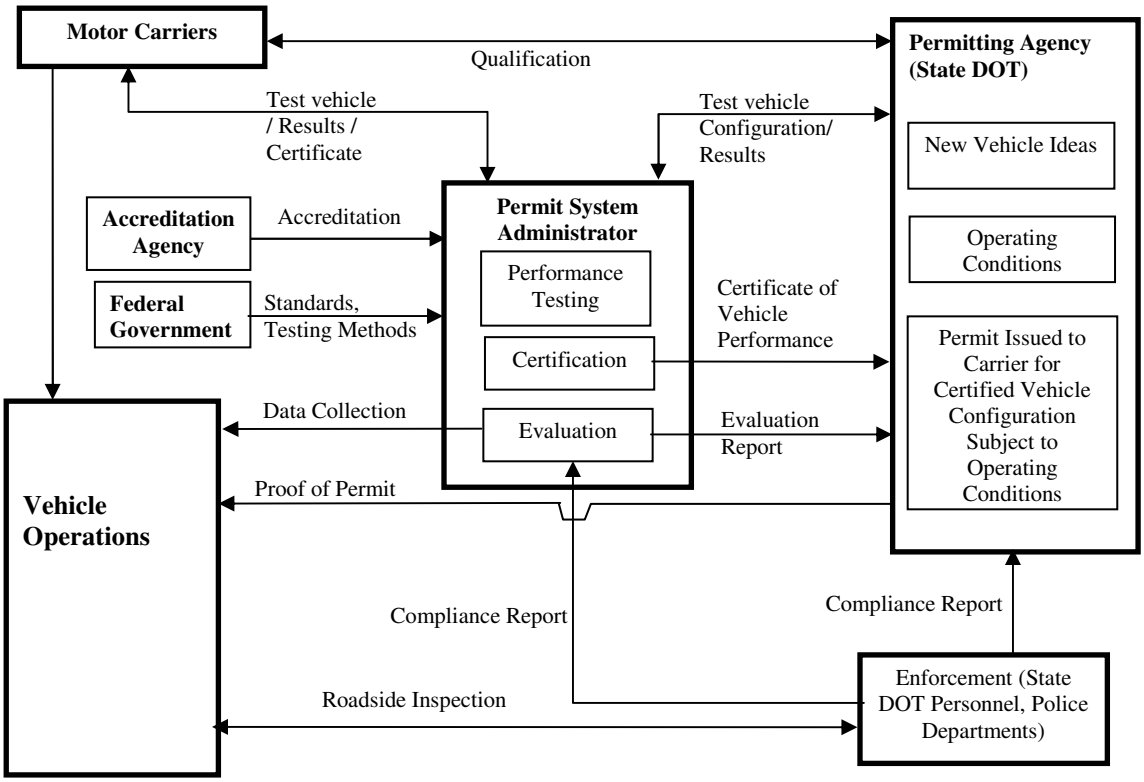

Figure 1. Structure of Performance-Based Permit System

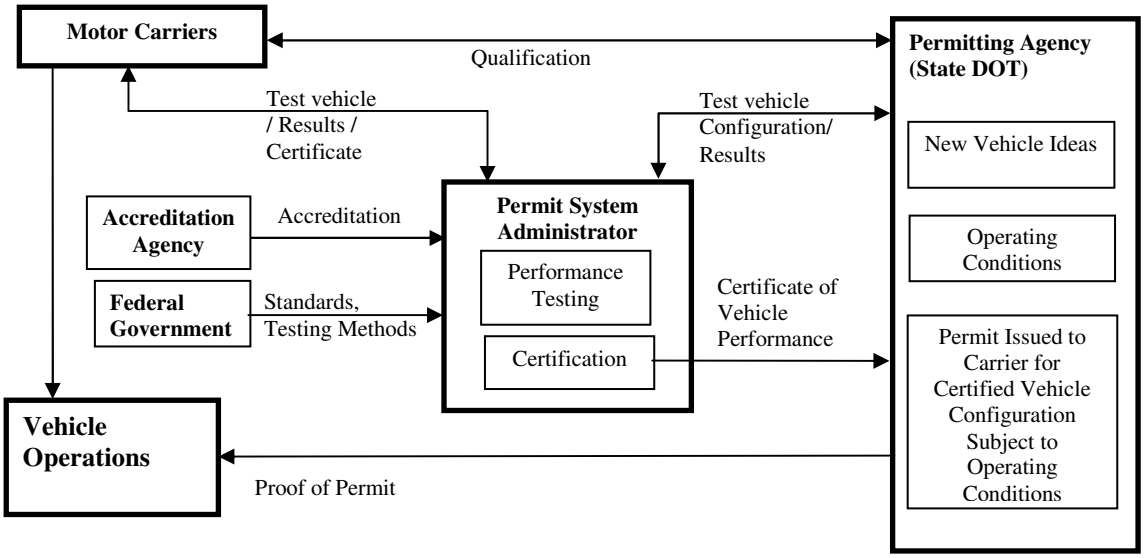

Figure 2. Administrative System

5.1.2 Testing and Certification

Certification defines performance standards and methods of assessment in evaluating and certifying candidate vehicle combinations to meet the requirements for safety and infrastructure performance. The two essential elements of the testing and certification process are (i) definition of performance standards, and (ii) specification of methods for performance assessment.

5.1.2.1 Performance Standards Definition

Vehicle performance measures and standards for use in the performance-based permit system should be defined. It is expected that these performance measures also would be related to highway functional classes and traffic volumes. The following measures and thresholds in Table 1 are suggested as the core measures of performance. These measures and respective thresholds are derived from experiences in Australia, Canada, and New Zealand. Additional measures and thresholds may be added as needed.

Table 1. Core Performance Measures and Thresholds

Performance Measure	Criteria
Static Rollover Threshold	Greater than 0.35g
Rearward Amplification	Less than 2
Load Transfer Ratio	Less than 0.6
Low Speed Offtracking	6.0 m
High Speed Offtracking	Less than 0.46 m

5.1.2.2 Method of Performance Assessment for Certification

This aspect requires the development of a uniform performance assessment system that can be used by the permit system administrator for certification. For most performance measures, computer-based modeling is the preferred method of vehicle performance assessment, as variables can be controlled and testing errors can be eliminated while results can be audited after the testing. Computer models for simulating vehicle behavior must be approved and calibrated on a regular basis. Recognizing the limitations of computer simulations, some form of vehicle testing would be required to calibrate and validate the simulation models. This should be done periodically to ensure that the simulation models yield reliable results.

5.1.3 System Administration

The systems administration defines the administrators who would serve as the accredited agency or expert for testing and certifying vehicles. Certification can be either through the state permit agency itself or an independent (third party) system administrator. The use of a third-party system administrator does not necessarily mean the use of private agencies. Third-party permit system administrators could imply a federal agency or a multi-state consortium tasked with the testing, certification, and evaluation of the permit system.

5.1.4 Carrier Qualification

Carrier qualification defines the process for pre-qualifying carriers participating in the permitting program. The screening criteria are pre-set by each participating state. Participating vehicles are

pre-certified and the carrier's safety record and credentials routinely verified with state and federal agencies by the system administrator. A carrier qualification process would be developed considering safety-related criteria, such as crash history, FMCSA inspection history, SafeStat rating, state weight violation history, and insurance filing. Acceptance into the program is conditional and may be revoked upon evidence of violation of any of the conditions.

5.1.5 Operating Controls

This defines the operating conditions of permitted vehicles and can include such elements as minimum driver experience, time-of-day operating restrictions, inclement weather and road condition operating restrictions, enhanced safety equipment requirements, and the setting of load and traffic violation thresholds.

5.1.6 Type of Certification

Once a vehicle type has been certified, it would seem logical that the carrier be permitted to operate identical vehicle configurations without having to provide performance-based system compliance proof. In essence, the carriers will be permitted to operate vehicles similar to the performance-tested configuration only to carry the commodity it was tested with and will be restricted to similar classes of roadway and compliance with other operational conditions.

5.1.7 Permit Issuance

As the final step before issuing a permit, the state DOTs should define permit issuance procedures and requirements, including user fee structure. In addition, a mechanism for fee collection and distribution procedures as well as auditing provision for compliance should be clearly defined. The type and duration must be determined by the participating state. Fees that are charged for the permit will be determined by the states within the guidelines/ parameters issued by the U.S. DOT. Federal fee structures also would be adjusted to recover the federal share of any added infrastructure costs and to pay for federal costs to administer the permit program. The fee structure could also include an incentive scheme to encourage the use of better performing vehicles. To the extent possible, such an incentive scheme should reward truck operators that use better performing truck configurations with lower permit fees.

5.2 Enforcement System

Enforcement is critical in assuring compliance with all laws, rules, and regulations governing the operation of trucks and truck combinations on the highway system. The enforcement system needs to consist of more than just the physical presence of law enforcement officers. It includes regulations, special conditions, education or communication to the industry, effective fines or penalties for violators, and adjudication. A performance-based approach to permitting larger and/or heavier trucks requires a futuristic enforcement system with the use of transponders and other electronic and communication methods. Figure 3 illustrates the enforcement system.

The enforcement system must consider operating conditions that assure the field enforcement officer that he/she can easily recognize a "legally permitted" truck or truck combination, and not feel compelled or required to measure or weigh it. Enforcement could assume 100 percent compliance with the requirements since there would be a process in place to ensure that a carrier and vehicle receiving a permit has been approved and certified in a structured process involving qualification, certification of vehicle configuration, and use of operating controls. Deviations from the permit requirements (e.g., routes, loading, speed) constitute violations. Violations

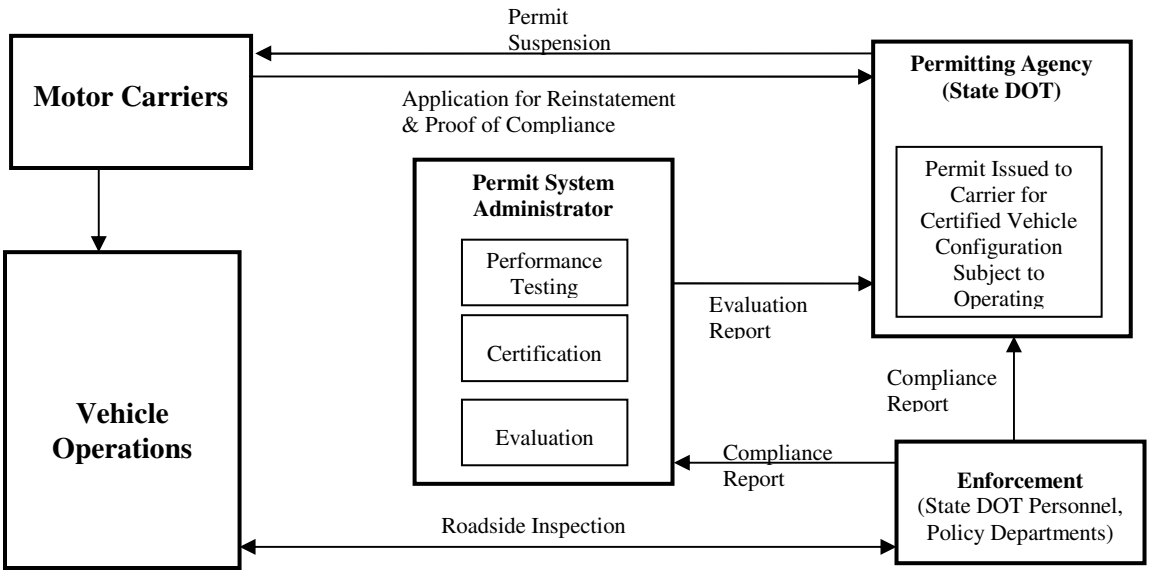

Figure 3. Enforcement System

should result in permit revocations and vehicles violating the provisions of the special permit should be suspended from operation (placed out-of-service) and the vehicle restrained until the carrier demonstrates compliance.

Enforcement data would be collected from the transponder and recorded daily on an event-by-event basis by the local law enforcement personnel. The data are then transferred and downloaded to a clearinghouse maintained by the permit system administrator. Periodically, the permit system administrator will produce a record for the state DOT and carrier that shows the operation of the carrier vehicles is in compliance with the pre-established routing, permitted time-frame, and conditions for operation (e.g., weight, size, configuration). The system administrator will also produce a record for enforcement that indicates carrier compliance or non-compliance with conditions of permits and the frequency of these events

5.3 Evaluation System

The evaluation system defines the data and processes to ensure that the permitting system is continuously evaluated. Evaluation is intended to measure the consequences of changes in dimensions, weights, and operating practices. Continuous evaluation of vehicles operating under the permit system is proposed. The results of the evaluation are necessary for revising the performance standards and limits for the permitted vehicles. Figure 4 shows the structure of the evaluation system.

The definition of vehicles eligible for permitting would be subject to review over time, based on the results of the evaluations. Thus, a key premise of the TRB study was that regulations should be dynamic and that changes should be considered based on the evaluations conducted. Federal reviews of the performance of the permitting program would be permanent and ongoing, and the program's results would guide the revision of the limits.

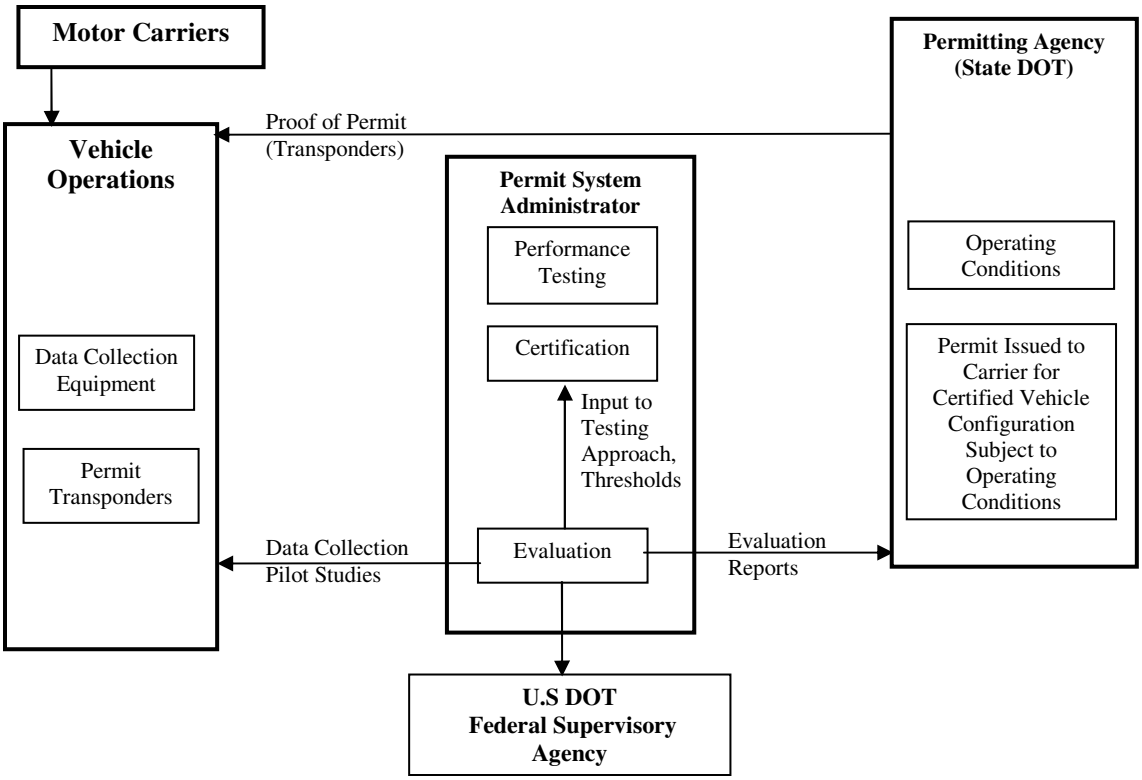

Figure 4. Evaluation System

T he notion of a performance-based system, on the other hand, may seem to be static in that a set of performance criteria are established and all vehicles must conform to those criteria. The criteria or threshold values for the various performance measures should be redefined, depending on the vehicle type and operating conditions. Therefore, once the vehicle configurations and operating conditions continue to change, the threshold values need to evolve accordingly.

The OS/OW permit framework allows for a structured evaluation of these goals by providing a basis for data collection and carrier co-operation. The carriers, as a part of the permitting project, would agree to participate in pilot tests for a period of three to six months. This three to six-month period allows early feasibility testing and validation. The three to six-month test adds a layer of intermediate testing before new vehicle types are allowed to operate.

6 CONCLUDING REMARKS

A conceptual framework for a performance-based oversize and overweight permitting system was developed based on information derived from the state of the practice in performance-based, OS/OW permitting systems in Australia, Canada, and New Zealand and OS/OW permitting practices in the United States. The framework consists of three main interrelated components: administrative, evaluation, and enforcement systems. A unique feature of the framework is the evaluation component, where the performance of the system is continuously monitored and results are used in revising the performance measures. Feedback from the evaluation and

enforcement systems into the administrative system allows for overall assessment of the performance of the permitting system in meeting the goals of improving highway safety. Periodic re-assessments of permitted vehicles in addition to continued roadside enforcement of operating conditions is recommended. It is also advised that this permitting framework be tested through pilot studies, using a few vehicle configurations (e.g., six-axle tractor semitrailer truck at 90,000 lbs and double-trailer configurations with each trailer up to 33 feet long), before implementation is extended to other vehicle configurations.

7 ACKNOWLEDMENTS

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8 REFERENCES

Battelle (2004). "Framework for a Federally Supervised, State-Administered Performance-Based Oversize and Overweight Permitting System." Final Report submitted to Office of Policy, Federal Highway Administration, U.S. Department of Transportation. Washington, DC.

Australia National Transport Commission (NTC) Homepage. www.ntc.gov.au. Accessed October 10, 2005.

Bruzsa, L. and Hurnall, J. (1996). "The Use of Performance-Based Standards for Long Vehicle Combinations – A New Approach in Vehicle Regulations." *Pro. 6th Int Heavy Vehicle Seminar*, IRTENZ, Christchurch, New Zealand, 1996.

Land Transport New Zealand Homepage. http://www.ltsa.govt.nz/index-ltsa.html. Accessed October 10, 2005.

Transportation Research Board (2002). *Regulations of Weights, Lengths, and Widths of Commercial Motor Vehicles,* Special Report 267*,* National Research Council, Washington, D.C.

Transport Association of Canada (TAC) (1988). *Canada's Memorandum of Understanding on Vehicle Weights and Dimensions*. Ottawa, Canada.

U.S. Department of Transportation (2000), *Comprehensive Truck Size and Weight (CTS&W) Study*, FHWA, U.S. Department of Transportation, Washington, D.C.