

Implementation Of Vehicle Weight And Dimension Regulations

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ABSTRACT

Implementation of truck weight and dimension regulations in a truly uniform manner across several jurisdictions has been a regulatory objective but an elusive goal. This paper traces the recent development of truck weight and dimension regulations in North America, and identifies factors that affect choice of vehicle configuration when vehicles are to be operated under different weight and dimension regulations, either within one jurisdiction, or across borders between several jurisdictions. These go far beyond the actual regulations, and must be fully understood from the point of view of all jurisdictions before the question of change can even be approached.

The paper suggests an approach to harmonization of truck weight and dimension regulations across multiple jurisdictions, which recognizes that initial differences that might exist in their regulations, and would need to be maintained.

INTRODUCTION

Jurisdictions with control over heavy truck weight and dimension regulations exercise their sovereignty according to their own imperatives. This has led to a process of "ratcheting" of regulations, where the allowables in one jurisdiction have increased slightly over those of its neighbours. Ratcheting has led to a multiplicity of competing and confounding regulations within geographic trading regions, like the countries of Europe, the provinces of Canada, the states of the United States of America, and the states of Australia. It has led to some extreme situations between two neighbouring jurisdictions where the preferred configurations for some type of freight within each of the jurisdictions may be quite different, and the preferred configuration for trade between the two is different again. These situations clearly increase the cost of transportation, though it seems to be difficult to get a realistic estimate of this cost. Now that the process of developing trading partnerships is accelerating, differences in heavy truck weight and dimension regulations are consistently identified as one of the principal barriers to trade.

Efforts have been ongoing in the European Economic Community, practically since its formation, to harmonize the truck weight and dimension regulations of member states. The

U.S. federal government took some small steps by setting some minimum maximum weights and dimensions for the interstate highway system in its Surface Transportation Assistance Act of 1982. Canada's provinces jointly developed standards for configuration, weights and dimensions of vehicles that all provinces agreed to adopt [1]. These processes seem only to have added new layers of regulation and complexity, and may have made some aspects of compliance more difficult.

Efforts at harmonization are nevertheless gaining momentum. Australia is now going through a federally mandated process to harmonize the states truck weight and dimension regulations. Canada continues to recognize that differences in truck weight and dimension regulations are a barrier to trade [2], and a recent domestic trade agreement requires that these barriers be removed. The North American Free Trade Agreement also requires its three partners to harmonize the broad field of land transportation standards, which include truck weight and dimension regulations. Finally, various regional groups of provinces and states continue to develop their own harmonization initiatives for legal vehicles, permit program vehicles and oversize/overweight permit loads.

This paper traces the recent development of truck weight and dimension regulations in North America, examines the effect of recent attempts at harmonization, and draws some conclusions from these that could form a basis for future approaches to harmonization of truck weight and dimension regulations. This paper is intended to move beyond considerations of technical performance to discussion of means to implement truck weight and dimension regulations in a truly harmonized manner across many jurisdictions.

All opinions expressed in this paper are the author's. No relationship to policies of Ontario Ministry of Transportation should be construed.

HISTORY

WEIGHTS AND DIMENSIONS IN CANADA

Canada's provinces and territories have jurisdiction over their highways and the vehicles that operate on them. Each has used this to set its own truck weight and dimension limits, in its own format, in its own law and regulations. The federal government has no truck weight and dimension regulations, and

its safety standards for design and equipment of new vehicles have no influence on vehicle configuration or weights and dimensions.

Prior to 1970, the truck weight and dimension regulations in Canada and the U.S. were rather similar. Typically, maximum gross weight was about 33,000 kg (73,000 lb), maximum overall length was 19.8 m (65 ft), the predominant vehicle was a tractor-semitrailer with a 13.7 m (45 ft) semitrailer, and there were few doubles. Substantial overloading in Ontario was not causing the infrastructure distress that would be expected, and a study of truck loads and bridge responses, including full-scale bridge testing, found significant bridge capacity that was not represented by conventional methods of analysis. This led to development of the Ontario Bridge Formula, which evaluates the effect of multiple axles on simple span structures [3].

Ontario introduced weight regulation by the Ontario Bridge Formula in 1970, with a gross weight cap of 63,500 kg (140,000 lb), increased axle weights, and greater weight on axle groups with greater spread. The regulation did not control vehicle configuration in any way, and quickly resulted in a wide variety of new truck configurations and axle arrangements that were designed to maximize gross weight and operational efficiency [4]. These included heavy haul semitrailers with liftable axles, truck-trailer combinations, and more doubles, that provided industries shipping heavy or bulk commodities with a significant improvement in transportation productivity. The bridge formula proved to be an unenforceable form for regulation, so it was replaced in 1978 with a series of tables. Subsequent changes in regulations have only been to dimensions, but these have had significant effects on truck configuration, axle group loads, and gross weight.

Ontario's large gross weight increase in 1970 put pressure on other provinces for similar changes. This resulted in a national study of bridge capacity [5], which showed that despite considerable apparent diversity, provincial weight and dimension regulations all followed Ontario's bridge formula quite closely [6]. By 1981, highway strengthening programs allowed an increase in axle loads and gross weights in other provinces to 80-90% of Ontario's, with British Columbia and Yukon matching Ontario's 63,500 kg (140,000 lb). Overall lengths reached 21 to 23 m (69 to 75 ft 6 in), and doubles became much more popular. The three prairie provinces and the four Atlantic provinces each developed their regulations to provide considerable regional uniformity in format and weight and dimension allowables, though there remained significant differences between these two regions and the other three provinces.

The bridge study recognized that further increase in gross weight was possible, but other provinces and territories were not prepared to accept the truck configurations or axle arrangements commonly used in Ontario to generate these weights. The CCMTA/RTAC Vehicle Weights and Dimensions Study was initiated in 1984 as a joint project between all provinces and territories, the federal government, and industry, to address this issue. It examined the impacts of axle group loads on pavements, and the stability and control performance of a wide range of heavy truck configurations. It developed vehicle performance standards based upon relationships between the characteristics of the most widely accepted vehicles and roadway dimensions to set the standard for satisfactory performance [7]. These provided a rational and objective means to define weight

and dimension parameters and vehicle configurations that became the basis of a Memorandum of Understanding Respecting Heavy Vehicle Weights and Dimensions, hereafter referred to as the M.o.U. [1], initially concluded in 1988, and subsequently amended in 1991 and 1994 [8]. This was the first step towards a national standard for truck weights and dimensions in Canada. It resulted in acceptance of tridem axle groups in the western provinces, and an increase in tandem axle load to 17,000 kg (37,478 lb). The M.o.U. defined weight and dimension limits for tractor-semitrailers and A-, B- and C-train double trailer combinations, and required each jurisdiction to allow vehicles within these limits to operate freely on a highway system designated by that jurisdiction as suitable for operation of the vehicles. The B-train double, with a gross weight up to 62,500 kg (137,787 lb), became the configuration of choice for heavy loads. The allowable gross weight and volume of A- and C-train doubles were limited on the basis of some deficiencies in their performance.

The six eastern provinces have recently begun an initiative to harmonize their truck weight and dimension regulations. This is intended to standardize axle group spreads and loads and provide greater recognition for M.o.U. configurations, and aims for eventual elimination of the use of liftable axles.

SIZE AND WEIGHT IN THE U.S.

The states in the U.S. are also responsible for truck weight and dimension regulations. By the mid-1970's, most states had accepted a 36,288 kg (80,000 lb) gross weight limit, and allowed double trailers. A few states persisted with the older gross weight limit of 33,240 kg (73,280 lb), or prohibited doubles, and the trucking industry was successfully using the courts to remove these restrictions on the grounds that they were a hindrance to inter-state commerce. The Surface Transportation Assistance Act (STAA) to re-authorize the Highway Trust Fund in 1982 pre-empted this activity to ensure uniformity of truck weights and dimensions on a designated highway system that included the interstate and federal aid primary highway system. It required states to allow semitrailers at a maximum length not less than 14.65 m (48 ft), doubles consisting of two trailers at a maximum length not less than 8.53 m (28 ft) each, a single axle load not less than 9,072 kg (20,000 lb), a tandem axle load not less than 15,422 kg (34,000 lb), and a gross weight governed by Bridge Formula B, but not to exceed 36,288 kg (80,000 lb). The states rights to allow trucks under their old regulations remained in place. These local regulations result in some very heavy short trucks in the northeast, some very heavy 11-axle combinations in Michigan, a range of longer and heavier trucks for resource hauls in western states, and long combination vehicles (LCV's) for general freight in many western states and on some toll roads.

The U.S. conducted two important studies in the late 1980's. The truck gross weight study examined alternatives to the current bridge formula [9]. The Turner study followed the methodology of Canada's Weights and Dimensions Study to determine heavy truck configurations having acceptable safety performance with lower axle loads for reduced pavement wear and more axles for increased gross weight [10]. Both concluded that up-front bridge costs would be a significant constraint to any significant increase in truck gross weights.

The Intermodal Surface Transportation Assistance Act (ISTEA) to re-authorize the Highway Trust Fund in 1991 was marked by a fierce and very effective campaign by opponents of

trucking. ISTEA therefore not only made no changes in truck weight and dimension regulations, it restricted doubles with gross weights over 36,288 kg (80,000 lb) to operation on their current route network, and prevented states from making further interpretation of their grandfather rights over truck weights and dimensions. This legislation appears to prevent further diversity in these regulations until 1997, when the Highway Trust Fund must next be re-authorized. Despite this, the 16.2 m (53 ft) semitrailer has become a virtual standard in the U.S., though in many states it cannot go on all roads.

FACTORS AFFECTING VEHICLE CONFIGURATION

TRUCK WEIGHT AND DIMENSION REGULATIONS

The paper uses the term "truck weight and dimension regulations" in a general sense to describe the entire body of law, regulations and policies governing the use of heavy trucks in a jurisdiction.

Law is contained in the statutes of a jurisdiction, and can only be amended by legislation enacted by that jurisdiction's legislative assembly. Law is inflexible, so it often contains only the most general provisions, then confers the authority to make regulations to contain the technical details upon some agency, like a department of transportation or road authority. That agency is usually also given the authority to issue special permits for loads that cannot be moved within weight and dimension limits, and for vehicles beyond those limits.

Regulations are established and amended by an administrative process that does not require passage of legislation. Regulations can be easier to change than law, though changes still require approval by the executive branch of government.

Policies describe how law and regulation should be interpreted, and are usually contained in operational manuals prepared by a jurisdiction for use by its staff. They reflect the influence of case law on law and regulations. Policies are changed by administrative decisions within the jurisdiction.

Law and regulations have a clear and obvious effect on truck configuration. Policies include the range and level of enforcement, tolerances on axle and gross weights, permit conditions for loads, and permit programs for classes of vehicle. These also have a considerable effect on vehicle configuration, especially when a vehicle will be operated only within one jurisdiction, or within a few adjacent jurisdictions. The effects of policies are much less obvious, as the policies themselves are generally not widely known, and differ between jurisdictions.

DEFINITIONS

Truck weight and dimension regulations are based on definitions of terms in law and regulation. Definition of heavy truck terms appears to be difficult, and gives rise to operational problems. A definition may not conform to common industry usage, so may be misunderstood or misinterpreted. Ontario uses the term "dual axle unit" instead of the more common "tandem axle group", and has an important distinction between the terms "axle unit" and "axle group". A definition may be incomplete or non-specific, so that it does not properly describe equipment that should be included, or includes equipment that should be excluded. Common definitions of the semitrailer, for instance, often include the pony trailer, also variously called the stiff-pole pup, pony pup, centre axle or dog trailer, even though it is quite

a different vehicle from a semitrailer and has quite different uses and performance characteristics. Definitions may be outdated. Equipment and devices may exist that are not defined, so can hardly be regulated. Definitions may also be unduly complex, sometimes due to repairs necessitated by judicial interpretation.

TIRES

There are a range of different tire loads specified by various jurisdictions. However, tires generally have a sufficiently high load rating that a 250 or 275 mm (10 or 11 in) wide tire can support the highest single axle load, and therefore is also adequate for tandem or tridem axle groups, where the wheel loads are lower than for single axles. Tire load rating and allowable load are really only a concern where single tires are used, or for over-weight special permit conditions.

AXLES AND AXLE GROUPS

The majority of jurisdictions across North America provide one load for the practical range of spread of tandem axle groups. As a consequence, tractors are manufactured with a tandem drive axle spread in the range 1.3 to 1.4 m (52 to 54 in), and trailers with a tandem axle spread of 1.25 m (49 in), as there is no weight benefit to offset the higher maintenance cost of a wider spread.

The six provinces of eastern Canada all allow more load on tandem and tridem axle groups for wider spread, and this is used extensively both to achieve the highest possible gross weight with the fewest axles, and to provide axle capacity beyond the allowable gross weight to gain some cushion against axle overloads. The majority of tractors are therefore purchased with a tandem drive axle spread of 1.52 m (60 in), and trailers with a tandem axle spread of 1.83 m (72 in), as the additional weight does offset higher maintenance costs.

The 3.05 m (120 in) trailer tandem axle spread that arises from the U.S. federal bridge formula appears to be widely accepted by states. Vehicles configured in Michigan may have large numbers of closely spaced axles and lesser numbers of widely spaced axles, because this state allows a minimal 5,897 kg (13,000 lb) on axles spaced at least 1.07 m (42 in) apart, but 8,165 kg (18,000 lb) on axles spaced more than 2.74 m (108 in) apart. Canada's national M.o.U. appears to allow more load for wider tridem axle spread, but in fact restricts loads for spreads less than 3.6 m (144 in), based on bridge deck structural limitations.

AXLE GROUP SPACINGS

The minimum axle group spacings that allow maximum axle group loads are derived from considerations of the appropriate bridge formula. There are three basic regulatory approaches. The first does not prescribe axle group spacings, but simply uses the bridge formula to evaluate the combined load allowed for two or more axle groups, whatever their spacings may be. Ontario's weight tables and the U.S. Formula B are examples of this approach, which results in most cases in vehicles configured with the minimum spacing for maximum axle group loads, though this is not always the case. The second prescribes minimum axle group spacings, and does not accept vehicles with lesser spacing. Implementation of Canada's M.o.U. in the western provinces is an example of this approach. The third also prescribes minimum axle group spacings, but includes a "download formula" or table to reduce the combined axle group loads

if that minimum spacing is not met. This is used by a number of Canada's provinces.

These different approaches, and different bridge formulae, have produced different requirements for axle group spacing in different jurisdictions. Quebec implicitly allows full load for a single axle 3.05 m (120 in) ahead of a tandem axle or 2.44 m (96 in) ahead of a tridem axle, whereas Ontario requires 2.5 m (98 in) in both cases. Such rules make it difficult to configure vehicles for use between some jurisdictions, may effectively exclude some vehicles from some jurisdictions, or may just defy reason. For instance, a tractor-semitrailer configured with Michigan's 2.74 m (109 in) axle spacing can increase its allowable gross weight in Ontario, by raising its foremost trailer axle to achieve Ontario's minimum 3.6 m (142 in) axle group spacing for maximum allowable gross weight.

OVERALL DIMENSIONS

A carrier moving a low-density commodity needs the largest possible cargo volume to move the largest shipment in one load. Because height and width are already limited, the only choice is to make the box the maximum allowable length. However, to move the highest weight of a dense commodity, the trucker needs a vehicle with the highest gross weight capability. The weight may not demand a very large cargo volume, but any bridge formula that determines the greatest allowable gross weight requires some minimum number of axles with axle groups spread apart by some minimum spacings. This tends to result in a minimum length that may be much larger than that needed just to carry the load itself, perhaps even the maximum allowable dimension. Configuring trucks for maximum allowable gross weight is intimately related to dimensions.

Canada's M.o.U. was based on a technical study that recommended a semitrailer length of 16.2 m (53 ft) and an overall length of 25 m (82 ft) for doubles. However, it was concluded at the then-current standards of 14.65 m and 23 m (48 ft and 75 ft 6 in) respectively, due to concerns about length expressed by the eastern provinces. The four western provinces adopted the original technical recommendations for length into their regulations in 1989, so the M.o.U. had an immediate impact because it provided substantial increases in both weight and dimension. In the rest of Canada, the provinces simply accommodated the M.o.U. with the minimum change necessary to their regulations, and it had little impact because it provided minimal additional dimensions and less weight than allowed on many existing vehicles. This created some difficulty, as there are small but important detailed differences in configuration of B-trains between 23 and 25 m overall length that inhibited the full benefit of the 25 m overall length. Quebec recognized the 25 m M.o.U. B-train in 1991, and Ontario finally passed legislation to allow this length for any M.o.U. double trailer combination in 1994, after several years of allowing them to operate under special permit at 23 m. Ontario allowed limited operation of 16.2 m (53 ft) semitrailers by special permit from 1990, and they also became legal early in 1994. Quebec and the Atlantic provinces now also allow these vehicles to operate under special permit. The national M.o.U. was therefore recently amended to reflect 16.2 m semitrailers and 25 m doubles, in accordance with the original technical recommendations [8]. The M.o.U.'s internal and overall dimensions have now been adopted fairly consistently by the provinces, so there is now finally something close to a national

standard for these vehicles. There remain, however, some small differences in internal dimensions and equipment requirements, and differences in allowable axle group loads between provinces still results in some differences in axle group spreads for equipment designed to operate in different parts of the country.

In the U.S., the STAA prescribed minimum values for maximum dimensions that the states were required to provide. This would seem to have been a reasonable approach, as it respected the rights of those states that already allowed greater length. However, it did not restrict or coordinate future setting of length. It has resulted in semitrailer length increases to a current *de facto* standard of 16.2 m (53 ft), or longer, accompanied by a haphazard range of internal dimensional limits and other requirements. Double trailer lengths exist from the STAA's 8.53 m (28 ft) up to 9.14 m (30 ft), with some states prescribing a box length limit, sometimes with additional trailer length controls. The number, form and value of these various requirements differs between states. This has made it very difficult for manufacturers and carriers to be sure they are complying with all requirements for what should be totally standard "go everywhere" pieces of equipment. The STAA also prohibited an overall length limit for tractor-semitrailers and doubles on the interstate and federal-aid primary highway systems. This clearly conflicts with other roads in many states, and Canada, where strict overall length limits are imposed.

VEHICLE CONFIGURATION

There are two regulatory approaches to vehicle configuration. Either the regulations prescribe the configurations that are allowed, and specify dimensional limits and gross weights, or the regulations are silent on configuration and simply provide overall dimensions and some form of allowable gross weight.

Canada's national M.o.U. defines vehicles on the basis of internal and external dimensional limits and axle group loads and axle group spacings. These specifications ensure that most vehicles meeting the limits also meet objective performance standards related to highway safety. This is a very tight prescriptive approach to vehicle configuration. Many jurisdictions have similar approaches, though often with less detail. Where a jurisdiction prescribes the vehicle configuration and loads, carriers domiciled there have a high degree of certainty of what is expected of them, and compliance tends not to be a serious problem. Most problems arise with vehicles that do not conform to some part of the prescription and arrive from more liberal jurisdictions.

It has become very clear that overall dimensional limits and a bridge formula can produce vehicles with less than desirable properties as vehicles [11, 12]. Trucks in eastern Canada and Michigan, and others now emerging in a number of states, can generate high gross weights by using large numbers of axles. Unfortunately, they cannot turn, and in the absence of restrictions on liftable axles, these devices are widely used to solve this problem. When liftable axles are raised so that the vehicle can turn, bridge constraints may be exceeded by a very wide margin, axle loads may be extremely damaging to pavements, and the objective safety performance of the vehicle may be compromised [7, 11, 12].

GROSS WEIGHT

The allowable gross weight of a vehicle is typically the

lesser of the sum of allowable axle loads, a weight based on a bridge formula and determined by the number of axles and some lengths, or a registration fee paid. The allowable gross weight cannot always be achieved, often because the front axle or other axle groups cannot be loaded to their allowable loads. Truckers do not always understand this, and can accrue axle overload charges as a consequence.

The practical gross weight is whatever can be achieved between the operator's business approach and the enforcement policies of jurisdictions. These policies sometimes become known, and then effectively increase the allowable gross weight to a practical gross weight. Policy within one jurisdiction, and different policies between jurisdictions, can result in actual traffic and actual loads that would not be expected by a simple reading of the truck weight and dimension regulations.

DESIGNATED HIGHWAY SYSTEMS

All jurisdictions have highway systems with different classes of road. A jurisdiction with a limited designated highway system tends to create a dual fleet, with obvious inefficiencies, and may inhibit introduction of the preferred vehicles. The obvious ideal is that each jurisdiction should designate its entire highway system, to allow all vehicles to go everywhere, but this is not always possible due to real roadway geometric or bridge limitations. A limited designated highway system tends to favour carriers based in that jurisdiction, so is a barrier to trade.

SEASONAL LOADS

Jurisdictions that enjoy the northern winter may allow some higher loads during winter months, sometimes only for specific commodities. During the spring thaw period, loads may be reduced on a part or all of the highway system. Where these differences are implemented by seasonal differences in axle loads, then the configuration and axle group spreads will be those that give the highest loads year-round. For example, in some of Canada's provinces prior to the M.o.U., a 7-axle B-train had the highest allowable gross weight in normal times, but an 8-axle A-train was higher in the thaw period so was the preferred year-round vehicle.

INTRODUCTION OF CHANGES

Currently, jurisdictions introduce changes to their truck weight and dimension regulations when they are able to. Where the item being changed is in law, timing may be subject to a legislative schedule driven by broader political considerations. If the item is in regulation, change may be easier to make, but is still subject to the constraint that truck weight and dimension regulations are often highly controversial. The result is that when jurisdictions try to make the same change, they are unable to do so in a coordinated manner. It may be made first in one jurisdiction, then another, allowed on an interim basis by permit in another, with additional requirements in another, and so on. Where changes are tied to equipment requirements, the effective date for that requirement stays with the vehicle for its life. This makes it very difficult for industry to plan and operate.

AN APPROACH TO HARMONIZATION OF TRUCK WEIGHT AND DIMENSION REGULATIONS

PURPOSE

Truck weight and dimension regulations should be harmonized so that vehicles that meet a defined standard can travel freely without let or hindrance on a designated highway system between jurisdictions. If the standard is widely known, then operators are sure that their equipment will comply in all jurisdictions.

SCOPE

There is clearly far too much invested in the current system of truck weight and dimension regulations, and the vehicles it has created, for it to be practical to replace it in its entirety. Harmonization is intended to reduce barriers to inter-jurisdictional trade, so only those vehicles that have significant involvement in inter-jurisdictional trade need be considered. This covers a range of tractor-semitrailer and double trailer combinations in general-purpose body styles like vans, flatbeds and tankers, and some special-purpose body styles for specific commodities like container chassis and car carriers. It might well exclude such vehicles as end-dump trailers and log trailers, which generally operate in local markets that are within one jurisdiction or in a border region of two jurisdictions. It could also exclude straight trucks, which generally also operate locally, though there may be a case for including them to the extent that truck-trailer combinations are a factor in inter-jurisdictional trade.

The scope for harmonization seems to be limited to a small number of specific vehicle configurations, and some commodity-specific body styles, that are widely and significantly used in inter-jurisdictional trade.

APPROACH

The model regulation When jurisdictions have agreed or been obliged to harmonize truck weight and dimension regulations in the past, they have implemented the requirements within the constraints of their existing law and regulations, and subject to their own interpretations. This has resulted in immediate differences. Truck weight and dimension regulations can only begin to be harmonized if all jurisdictions adopt exactly the same regulation, word for word. This can only be done if there is one model regulation that is adopted by reference by each jurisdiction. This means it is referred to, by name, from the jurisdictions own regulations. Its text, verbatim, then becomes the jurisdiction's own regulation. This procedure is fairly widely used for standards that are highly technical. Adoption by reference requires that the model regulation belong to an independent reputable body, that there is a process for maintaining it, and that it is available on demand.

The provinces and states clearly have jurisdiction over truck weight and dimension regulations, have exercised it wilfully in their own interest, and have resisted attempts to reduce their sovereignty. Setting truck weight and dimension regulations by reference to a model regulation owned by another organization would appear to cede some sovereignty to those who maintain the model. In fact, it can be argued that when a group of jurisdictions agree on a uniform course of action for their common good, and proceed to implement it, then it is not a reduction in sovereignty, but exercise of sovereignty at a higher

level. Jurisdictions should be able to retain full sovereignty, simply by reserving two rights. First, that they adopt the current version of the model regulation only when it is ratified by all parties after amendment, and with the effective date contained therein. Second, they retain the right to regulate vehicles not contained in the standard, which includes the right to create new classes of vehicle.

The model regulation should be written in plain language, with diagrams and illustrations, so that it is more readily understood by its users than most current regulation. It should use numerics throughout instead of written numbers. While it may be necessary for the model to use metric units, there should be no reason why an unofficial imperial translation could not be maintained and made available if it is not possible to use both systems of units in the model. These things are much easier to achieve if the model regulation is maintained by a non-governmental body that specializes in standards.

Definitions Truck weight and dimension regulations cannot be harmonized without definitions that are also uniform across jurisdictions. The model regulation must therefore also include definitions that can be adopted to serve as a basis for the defined classes of vehicle. In fact, a set of newly-developed definitions would probably be more up-to-date and relevant than many of the jurisdictions own definitions, so it could be more sensible for each jurisdiction to adopt the schedule of definitions for all their truck weight and dimension regulations. This might be quite difficult, as every jurisdiction has considerable investment in its current definitions, in staff and user training, and legal precedent. It might be necessary for some jurisdictions to provide an epilogue to the adopting clause that relates new definitions to older terms, perhaps stating inclusions and exclusions.

The package of definitions should cover parts of vehicles, the components, devices and assemblies that are the building blocks, and vehicles and combinations of vehicles. Common truck terminology should be used wherever possible, and the definitions should be sensible, direct and consistent. In many cases, common truck terminology itself is not tightly defined. It may be necessary either to tighten traditional usage, or invent new terms.

Content The model regulation should define several classes of vehicle that can go everywhere on the highway systems designated by the jurisdictions that are party to the harmonization. Each vehicle requires strict dimensional controls, which means that axle groups, axle group spacings and external and internal dimensions must all be defined and controlled, in most cases with both maximum and minimum limits. Conceptually, the truck must fit in a closed box with closed internal partitions.

Each vehicle should be completely specified, preferably in one or two pages, with diagrams and without reference to other standards or other parts of the model regulation. This might appear to be introducing considerable repetition or redundancy. However, if this is not done, information will be lost when one person copies a single page or specification from the model regulation and gives or faxes to another person.

Differences in road and bridge standards between jurisdictions, and different road classes within jurisdictions, mean that it will not be possible to set the same allowable axle and gross weights in all jurisdictions. Once dimensional limits have been established, it is necessary to ensure that they can be loaded properly in each jurisdiction. Axle and gross weights

should be scaled up or down in a compatible manner between jurisdictions so that vehicles of the given dimensions can be loaded to their allowable gross weight with a uniformly distributed load and their axle loads remain within allowable limits in each jurisdiction.

It could be argued that such a highly prescriptive form of regulation might inhibit innovation. On the contrary, if a vehicle is to travel widely between jurisdictions, it must operate to the highest common factor of the regulations of those jurisdictions. Currently, it can be difficult to find that common factor. Indeed, only tight specification of vehicle dimensions and configuration, that is accepted everywhere, can provide assurance to the trucker that the vehicle can, in fact, go everywhere.

It is concluded that truck weight and dimension regulations can only be harmonized between jurisdictions if a model regulation of tight prescriptive descriptions of specific and well-defined vehicle configurations is adopted by reference by all jurisdictions. The jurisdictions may continue to exercise their rights to regulate their other vehicles in whatever manner they wish.

Scheduling changes Different dates for introduction of essentially the same new regulation between jurisdictions, and different requirements, are the bane of carriers and leasing companies. If a model regulation can be introduced by reference into the regulations of a group of jurisdictions, it is possible that changes to the model regulation can be agreed by all jurisdictions and implemented automatically on the same date, in the same way, through all the jurisdictions. If only this can be achieved, it would certainly be a major simplification to industry.

Coordination of policies and penalties Enforcement and other administrative policies, and penalties, affect choices made by carriers. If harmonized regulations are introduced between a number of jurisdictions, the outcomes will still not necessarily be the same. To achieve the same outcomes, carriers must be treated in approximately the same manner by each jurisdiction. This means the jurisdictions must also harmonize those policies that will affect the outcomes. This is probably a much more difficult step than harmonizing the formal regulations, as policies seem to be based much more on the ongoing relationship between each jurisdiction and its own industry, having evolved from local resolutions of a series of local issues. Harmonizing penalties may also be extremely difficult, because these tend to be in law, so are difficult to change, and are also on a scale related to penalties for other offenses that tends to be rather jurisdiction-specific.

Regional harmonization The process outlined above will create a set of classes of vehicles that will be able to go everywhere. There are other vehicle configurations that are a common interest of a number of jurisdictions, perhaps only for a limited part of their highway systems, that are not acceptable to all jurisdictions. These might include, for example, western log trucks and LCV's like triples, Rocky Mountain doubles and Turnpike doubles. There is no reason why the model regulation should not allow a subset of jurisdictions to define standards for such classes of vehicle. Jurisdictions interested in these additional vehicles could adopt them as they wished, but there would be no obligation on any jurisdiction to adopt any of them. This would certainly help address a number of regional issues.

REGULATION BY PERFORMANCE STANDARDS

It is important to dismiss the concept that vehicles should be configured based only on objective performance standards. This idea has a lot of intellectual appeal, though experience to date has only shown its limitations. In jurisdictions where vehicles are configured using dimensional limits and loads based on pavement and bridge constraints, innovation in the pursuit of maximum gross weight has led to many classes of vehicle that cannot properly carry or distribute the gross weight they may theoretically accrue, and/or have significant other objective performance deficiencies. This has more recently been addressed by extending the number and range of performance measures [7]. These new performance measures primarily address vehicle responses that are objectively related to safety. They are abstruse, understood by only a small group of technical experts, and can only be assessed and evaluated by an even smaller group of experts. They cannot be considered accessible to the majority of truckers, who generally just want to know in simple terms what they must do to comply with legal requirements. If regulation was introduced based on performance measures, in addition to the previous constraints, there would be no means for roadside enforcement of standards for a particular vehicle with a particular load. This approach might work under a European-style process of type certification, where the manufacturer is required to conduct tightly specified analyses and tests to show compliance for a particular design, and can only manufacture vehicles of the exact specifications certified. It would probably not be possible in the current North American regulatory environment of self-certification, and there is no evidence of any change in that environment in the near future. The concern is that an incomplete set of performance standards, and the inability to enforce standards, will result in incomplete control of traffic [13]. There is clearly a wide range of possible performance standards, which have varying importance to different groups. Some are important to the manufacturer, some to the regulatory authorities (federal and local), and some are important to the operator. Without full agreement between jurisdictions on the number, scope, applicability, interpretation, evaluation and enforcement of such performance standards, regulation based only on performance standards would quickly lead to development of more classes of local vehicles in different jurisdictions. It would lead quickly away from harmonization, rather than promoting it.

OTHER VEHICLES

While it may be desirable to harmonize the truck weight and dimension regulations for the most common classes of vehicle involved in inter-jurisdictional trade, each jurisdiction will still have other vehicles from earlier weight and dimension systems. Each jurisdiction will probably feel the need to retain vehicles that do not conform to the harmonized classes, for a variety of reasons, and will make their own judgements on how to go about doing it. There will clearly be trade-offs between vehicles for domestic use, only within one jurisdiction, vehicles for trade between two adjacent jurisdictions, and vehicles that will travel more widely and would probably belong to one of the harmonized classes.

Jurisdictions that operate permit programs, such as for LCV's, should be able to continue to operate them.

CONCLUSIONS

Truck weight and dimension regulations have developed at national and local levels in incompatible layers within and between jurisdictions. Previous efforts to harmonize regulations seem only to have led to further layers of regulation, with further small but significant differences as each jurisdiction tries to bring the regulations within its own structure of law and regulation.

If efforts at harmonization are to succeed, technical and policy efforts must be coordinated in a regulatory development process that transcends geographic boundaries and jurisdictional limitations of legal structures. This means that where truck weight and dimension regulations are intended to be uniform across a number of jurisdictions, the particular set of regulations must be defined in one complete and self-standing model regulation that includes all pertinent definitions. Jurisdictions must adopt that model into their regulations by reference. Only by this means can it be assured that each jurisdiction will, in fact, define and regulate vehicles in the same way. Trucks must be defined by configuration, and maximum and minimum dimensions must be specified. In addition, jurisdictions must also coordinate enforcement and other policies, and penalties, to ensure the same outcome in all jurisdictions.

Such measures will create fleets of trucks that will be able to go everywhere on the designated highway systems of the participating jurisdictions. If a jurisdiction wishes to allow other trucks of greater weight or dimension than this common fleet, then it must retain the prerogative to do so.

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