

TRUCK TRANSPORTATION IN LATIN AMERICA: THE CASE IN COSTA RICA

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Abstract

This paper discusses the truck transport task in Costa Rica, particularly dealing with the truck size and weight (TS&W) regulations, vehicle safety regulations, enforcement practices, and compliance issues associated with this task. These issues were investigated through site visits, data collection and analysis of over one million truck records, and an extensive survey of local government and industry officials. The research revealed a significant disconnect between those who create TS&W regulations and measure compliance and those who enforce regulations. Despite the disconnect, the problem of overweight trucks in Costa Rica is small. Nearly all (99.8 percent) large trucks comply with gross vehicle weight (GVW) regulations. Few trucks are operating overweight but many more may be operating with vehicle safety issues. There are no roadside safety inspections for trucks in Costa Rica at this time so it is difficult to determine the compliance with respect to vehicle safety standards. Ensuring on-road compliance with truck regulations is necessary for road safety, the infrastructure, and regional integration.

Keywords: truck regulations, truck size and weight, safety, enforcement, international freight, trucking

1. Introduction

The Pan-American Corridor of Central America is the critical economic trade link between the Panama Canal and Mexico. The spine of the corridor is the Pan-American Highway and connecting highway links to major ports and trade origin and destination locations. Trucking along the corridor, between countries in the corridor, and to/from its ports is the principal (typically only) means of freight transport.

In terms of international freight movement in and out of Costa Rica by road, the majority of freight is transported through the Northern border to Nicaragua. The Northern border accounts for 80 percent of exports and 85 percent of imports in terms of weight by road (Carvajal, Fernández, & Salazar, 2008). Costa Rica's road network also serves three primary international ports, two located on the Atlantic coast and one on the Pacific coast. The key commodities moved by these ports in terms of weight are bananas in containers, petroleum and derivatives, and fruit containers. It is central to the economic development of the country to move these commodities effectively throughout the region. The primary highways, ports, and border crossings in Costa Rica are presented in Figure 1.

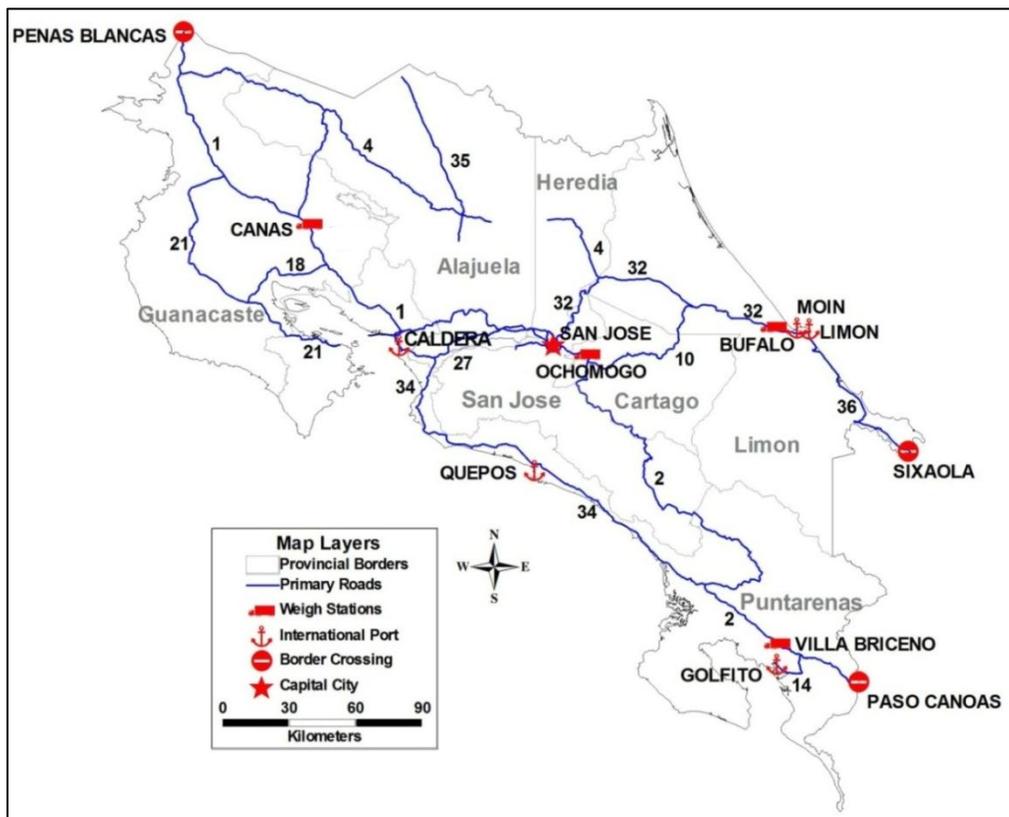


Figure 1 - Primary Highways, Ports, and Border Crossings in Costa Rica

This paper discusses the truck transport task in Costa Rica, particularly dealing with the truck size and weight (TS&W) regulations, vehicle safety regulations, enforcement practices, and compliance issues associated with this task.

Specifically, the objectives of the paper are to:

- understand truck size, weight, and safety regulations in Costa Rica;
- identify enforcement procedures for truck regulations; and
- determine the extent these regulations are adhered to through an analysis of truck weight data.

2. Research Method

This research was conducted during a six-month visit to Costa Rica, working with the National Transportation Laboratory (LANAMME or Laboratorio Nacional de Modelos y Materiales Estructurales), affiliated with the University of Costa Rica. The research involved: (1) site visits, (2) data collection and analysis, and (3) an extensive survey of government and industry officials.

Site visits consisted of traveling the primary highways in Costa Rica with respect to freight operations, visiting the three major ports within the country, the three border crossings with surrounding countries Nicaragua and Panama, and the four truck weigh stations. Site visits took place between February and June of 2010. The main purpose of these visits was to understand the characteristics of truck transportation and enforcement in the country.

Over the course of these site visits, nearly twenty organizations in both government and industry were surveyed. National government organizations include: the truck size and weight department, transportation planning department, ports department, and bridge department. Meetings were conducted with port authorities at the three primary ports in addition to a site visit to the Panama Canal expansion project. Those involved with the enforcement of truck size and weight regulations at the National Transit Police were interviewed along with those with the national vehicle inspection program. The personnel operating the four truck weigh stations were also interviewed.

For the data collection and analysis, several data sets were obtained over the course of the research, including vehicle characteristics and volume data, vehicle weight data, and road inventory data. Four permanent weigh stations provided the most robust data set with respect to fleet characteristics as they count year round, 24 hours a day and provide the basis for the data used in this research. The entire weigh station data set consists of 2,050,186 records for 2010 and this data was used to determine the level of weight compliance at the weigh station locations.

3. Results

Costa Rica's truck size, weight, and safety situation is defined in terms of laws, regulations, policies, and practices. Regulatory issues include truck size, weight, and safety regulations. Safety regulations can include the mechanical fitness of the truck fleet, driver hours of service, load securement regulations, and other relevant truck safety considerations. Ensuring on-road compliance with truck regulations is necessary for road safety, the infrastructure, and regional integration.

3.1 Truck Size and Weight Regulations and Enforcement Procedures

The Ministerio de Obras Públicas y Transportes (Ministry of Public Works and Transportation) (MOPT) is responsible for the control and regulation of truck size and weight on public roads in Costa Rica that further extends to the materials and goods they haul. Additionally, the regulations state that the government is responsible for the construction and operation of weigh stations on domestic routes for the purposes of regulation enforcement.

The truck fleet in Costa Rica primarily consists of vehicles in the C2, C3, T3-S2, and T3-S3 classes as designated by the national truck size and weight regulations. Although these four classes account for 95 percent of the truck fleet there are 30 different truck types that can legally operate in the country. Table 1 outlines the truck size and weight regulations for the four vehicle classes that account for most of the truck movements in Costa Rica.

Table 1 - Truck Size and Weight Regulations for Selected Vehicle Classes

| Class | Axle Configuration | Maximum Allowable Weight (tonnes)* | | | | Maximum Length (m) | Maximum Height (m) |
|-------|---|------------------------------------|------|------|------|--------------------|--------------------|
| | | Axle Group | | | GVW | | |
| | | 1st | 2nd | 3rd | | | |
| C2 |  | 6 | 10 | - | 16 | 12 | 4.15 |
| C3 |  | 6 | 15 | - | 21 | 12 | 4.15 |
| T3-S2 |  | 6 | 16.5 | 16.5 | 39 | 21 | 4.15 |
| T3-S3 |  | 6 | 16.5 | 23 | 45.5 | 21 | 4.15 |

* There is a tolerance per axle or axle group of 0.5 tonnes; however, this tolerance is not cumulative. Vehicles having up to four axles have a maximum tolerance of 0.5 tonnes and vehicles with five or more axles have a maximum tolerance of 1.0 tonne so long as the maximum allowable gross vehicle weight is not exceeded.

Source: MOPT

North American Influence on Costa Rica's Truck Fleet

The four primary truck classifications in Costa Rica exhibit similarities to trucks operating in the U.S. and Canada as many trucks are imported from these countries as used vehicles, particularly large trucks (tractor-semitrailers with 5 or more axles). With similar vehicle types, Costa Rica has similar truck size and weight regulations for the four primary vehicle types.

Costa Rica's C3 classification is similar to the FHWA Scheme F Class 6 vehicle (3-axle single unit); the T3-S2 is comparable to the Class 9 (5-axle tractor-semitrailer), and the T3-S3 to the Class 10 (6-axle tractor-semitrailer). The C2 vehicle classification posed an issue during this research in terms of standardization. There was great variability in terms of the size of two-axle single unit vehicles in Costa Rica. These vehicles make up nearly 40 percent of the truck fleet; however, because of the high variability within the classification they are not the focus of this paper. This paper focuses solely on large trucks (tractor-semitrailers with 5 or more axles).

Notable differences in truck size and weight regulations for Canada and Costa Rica include the maximum length of T3-S2 (5-axle tractor-semitrailer) and T3-S3 (6-axle tractor-semitrailer)

vehicles. Costa Rica's regulations limit maximum vehicle length to 21 metres while Canadian regulations allow up to 23 metres for these vehicle combinations. Imported vehicles in Costa Rica exceeding the allowable 21 metres may exist due to vehicles exceeding this length in Canada. For example, this could include vehicles with 53-foot trailers or tractors with sleeper cabs. Although imported vehicles are inspected upon their arrival in the country, the owner or operator may choose to use a shorter trailer to meet the length restrictions at the time of the inspection for vehicle registration. The weight regulations for GVW and axle group weights are similar, particularly after applying the allowable one tonne tolerance for large trucks in Costa Rica.

Suitability of North American Trucks in Costa Rica

Due to the vast number of imported trucks operating in Costa Rica, the national truck size and weight regulations comprise 30 different vehicle classes. These classes emulate characteristics from different jurisdictions across the U.S. and Canada, and from different time periods. This may result in imported vehicles operating on Costa Rica's highways that include trucks governed by outdated regulations or trucks that may not be suitable for the unique highway environment in Costa Rica. For example, a very common vehicle type in Costa Rica includes lift axles. While these types of axles are not allowed in some North American jurisdictions, and are currently being discontinued in others, they are common in Costa Rica as a result of this equipment being acquired by Costa Rican trucking companies. The impact that these lift axles have on the pavement is unknown but anecdotal evidence shows that these axles are not used in the way in which they are intended in the U.S. and Canada.

The T3-S2 and T3-S3 vehicles are typically the largest trucks observed operating on Costa Rica's highways. Although there may be productivity benefits to introducing B-trains or other large truck configurations in this region, it would likely result in negative impacts from a road safety perspective. Costa Rica is highly limited in terms of its topography which is characterized by densely vegetated, mountainous regions. The majority of primary highways consist of two-lane undivided highways and in most cases shoulders, passing lanes, climbing lanes, and truck escape ramps are not provided. Although the operation of larger trucks may serve a certain freight task in Costa Rica, without vigilant enforcement and adequate road infrastructure larger trucks may result in adverse safety impacts. Additionally, neighboring jurisdictions do not operate these larger truck configurations making harmonization and regional integration challenging for cross border trade.

Enforcement

The MOPT is responsible for the control and regulation of truck size and weight on public roads in Costa Rica; however, they do not have the authority to enforce regulations. The enforcement of regulations is the responsibility of the National Transit Police. Officials operating the weigh stations are only allowed to weigh the trucks but have no authority for issuing citations to vehicles that violate the regulations. If a violation occurs, the enforcement officials must contact the National Transit Police with a description of the vehicle for follow up. The vehicle may then be pulled over at a different location along the highway and the Transit Police can take appropriate action. This is rarely the case though as the Transit Police are often preoccupied with other tasks and truck size and weight regulation enforcement is not a priority to them.

The officials operating the scales are also not authorized to address truck safety issues that they may encounter, such as defective equipment as this is also something that is not addressed into

law and no-one has real jurisdiction over it. Issues also exist with trucks bypassing weigh scales as the Transit Police are not commonly stationed at the scale location. It was observed during the course of the research that the majority of trucks do enter the weigh station to be weighed despite the lack of physical enforcement presence. However, as previously indicated, they also know that there are no consequences in the case of being overweight.

3.2 Truck Safety Regulations and Enforcement Procedures

There are currently no laws or regulations with regards to truck driver hours of service, roadside safety inspections or enforcement programs for trucks with respect to safety regulations in Costa Rica. Costa Rica does, however, have a nationally implemented program requiring the inspection of all vehicles. The government requires all vehicles (passenger and commercial) to undergo mandatory periodic mechanical inspections. These are done at fixed, state-of-the-art centers located around the country. All vehicles must pass inspections to receive a decal for operation.

RITEVE is the national organization that conducts vehicle inspections and verifies that vehicles meet minimum safety conditions, based on design criteria and manufacturing. This is done under contract for the Costa Rican government.

The frequency of inspections is based on the age of the vehicle and the required inspection frequencies range from once a year to once every two years. During the inspection, vehicles are assigned one of four categories: (1) approved, (2) approved with minor defect, (3) not approved with a serious defect, and (4) dangerous defects. The first category consists of those vehicles with no mechanical fitness problems. Vehicles approved with minor defects are not required to report back to the inspection facility but are urged to make the repairs on their own. Vehicles not approved with a serious defect have 30 days to address the problem and return to the inspection facility for follow up. Vehicles with dangerous defects are no longer allowed to circulate until repaired and are often removed from the inspection station with a tow-truck.

Commercial vehicles have some of the highest failing rates on initial inspection. Trucks with GVW under 3,500 kilograms have a 64 percent failure rate; single unit trucks with GVW above 3,500 kilograms have a 74 percent failure rate; tractor-semitrailer combinations have a 68 percent failure rate, and commercial vehicles carrying dangerous goods have a 74 percent failure rate (RITEVE, 2010).

The organization tasked with completing the inspections provides a summary for the types and percentages of defects found in various vehicle types. Trucks greater than 3,500 kilograms are most likely to be rejected due to brake issues (42 percent), axle and suspension issues (27 percent), and signage issues (27 percent). Tractor-semitrailers are rejected most often for these same defects with 38 percent, 36 percent, and 20 percent, respectively. With slightly higher rejection percentages in these same categories, dangerous goods have defects of 40 percent, 34 percent, and 28 percent, respectively.

Although the vehicle inspections provide a certain level of coverage in terms of evaluating compliance with basic vehicle safety standards, the program does have limitations, particularly for large trucks. Two key issues emerge:

- Tractor-semitrailer combinations consist of two or more components. Typically, trailers in the best physical condition are chosen by the truck owners or operators for the

inspection process, although a tractor may haul numerous trailers throughout the year. This results in many trailers being excluded from the inspections and likely those in the poorest condition.

- Predictability of the inspection periods. With a scheduled inspection time an owner or operator can ensure that a vehicle passes at the time of inspection but the general day to day operating conditions of the vehicle may be quite different. Trucks are typically empty during the inspection procedure; however, issues could arise from the types of loads a vehicle is carrying and the securement of the load.

For these reasons it may be suitable to introduce a roadside inspection program in Costa Rica. This would help encourage owners and operators to have their vehicles in top mechanical condition at all times rather than at the known time of inspection. This may also help to provide extended coverage to include trailers that may not be captured by the current vehicle inspection program.

3.3 Weigh Station Data Analysis

Data from the four weigh stations operating in Costa Rica were analysed to obtain a better understanding of truck weight issues throughout the country. This analysis provides insight into the types of trucks operating in different regions of the country. The weight data is analysed with respect to axle groups and GVW for two vehicle classifications: (1) T3-S2 (5-axle tractor-semitrailers), and (2) T3-S3 (6-axle tractor-semitrailers). Figure 2 shows the types of vehicles that operate in the different regions of the country.

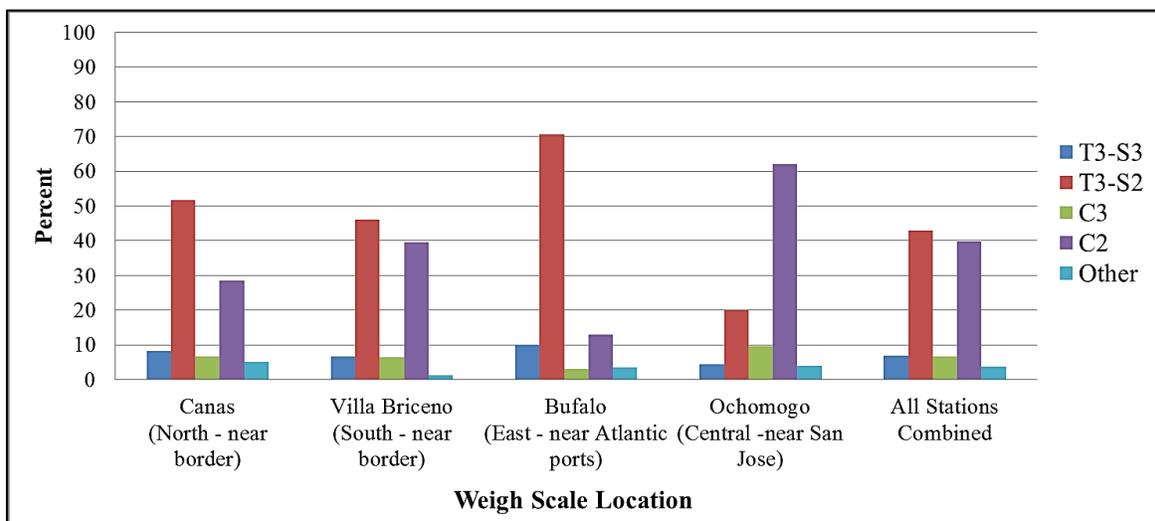


Figure 2 – Types of Vehicles Operating in Different Regions of Costa Rica

The Búfalo weigh station experiences a high number of T3-S2s and a smaller proportion of C2s. This location has a higher percentage of long haul, heavy truck trips carrying goods to and from the ports of Moín and Limón. The Ochomogo station located near San José has a higher percentage of C2 vehicles, likely carrying smaller loads over smaller distances due to its urban location. The weigh stations at Cañas and Villa Briceño, both located near international border

crossings, exhibit a greater variety in terms of heavy and light trucks. Overall, after combining weigh stations, 40 percent of the truck fleet consists of C2 vehicles and 40 percent T3-S2 vehicles. The C3 and T3-S3, and all other classes comprise the remaining twenty percent of the fleet.

T3-S2 (5-axle tractor-semitrailers)

The four weigh stations recorded a total of 881,076 T3-S2s in 2010. Of these vehicles, 99.8 percent (879,445 of 881,076) were found to be in compliance with the allowable GVW weight. The most significant overweight axle group was the drive tandem with 4.5 percent (39,925 of 881,076) of vehicles exceeding the allowable weight.

Since the drive tandem has the most significant issue with exceeding the allowable axle weight, the tolerance of one tonne was applied to it for the analysis (given that the tolerance is written into national law, therefore, for all intents and purposes, the axle weight could include that allowable tolerance). The tolerance may only be applied to one axle group as per the truck size and weight regulations. This allows an increase of weight from 16.5 tonnes to 17.5 tonnes on the drive tandem (or the rear tandem, but not both). After including this tolerance, the percentage of overweight drive tandems decreases from 4.5 percent to 0.6 percent. This demonstrates that by including an additional one tonne to incorporate the tolerance there are few overweight drive tandems, indicating that the drive tandems that are overweight are only overweight by a small amount (within the tolerance). Table 2 outlines the level of non-compliance for T3-S2 vehicles at each of the four weigh stations in addition to the total for the stations combined.

Table 2 - T3-S2 Non-Compliance with Weight Regulations

| Station | N | Percent Overweight | | | |
|---|---------|--------------------|---------------|---------------|-------------|
| | | GVW | Steering Axle | Drive Tandem | Rear Tandem |
| Búfalo (East-near Atlantic ports) | 584,337 | 0.05 | 0.05 | 3.27 (0.38*) | 1.52 |
| Cañas (West-near border) | 61,013 | 0.79 | 0.02 | 13.44 (2.76*) | 5.70 |
| Villa Briceño (East-near border) | 26,313 | 0.55 | 0.05 | 3.27 (0.55*) | 3.67 |
| Ochomogo (Central-near San Jose) | 209,413 | 0.08 | 0.07 | 5.63 (0.74*) | 3.33 |
| Total | 881,076 | 0.16 | 0.05 | 4.53 (0.64*) | 2.30 |

** Percentage of overweight drive tandem axle groups after applying one tonne tolerance.*

In terms of individual station analyses, the percentage of T3-S2 vehicles exceeding the GVW and individual axle weights remained consistent across stations/regions. Station locations are shown in Figure 1. The Cañas weigh station was an exception to this, having a significantly higher percentage of overweight drive tandems and rear tandems when compared to other stations. Figure 3 demonstrates the cumulative weight distribution for the T3-S2 vehicle classification. The figure shows that few vehicles exceed the drive tandem axle group weight limit and after applying the one tonne tolerance, nearly all vehicles comply with the country’s weight regulations.

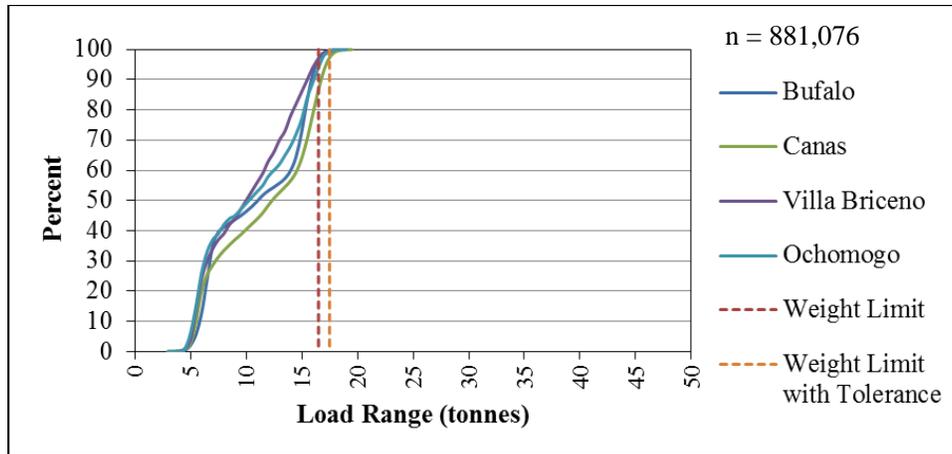


Figure 3 - T3-S2 Cumulative Weight Distribution for Drive Tandem Axle Group

Figure 4 demonstrates that very few T3-S2 vehicles operating in Costa Rica exceed the allowable GVW limit.

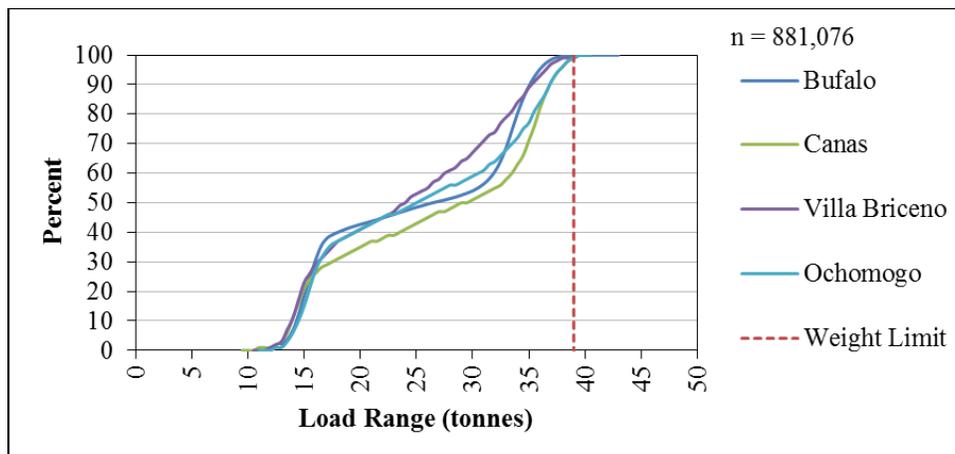


Figure 4 - T3-S2 Cumulative Weight Distribution for GVW

T3-S3 (6-axle tractor-semitrailers)

The four weigh stations recorded 141,349 T3-S3s in 2010. Of these vehicles, 99.6 percent (140,842 of 141,349) complied with the allowable GVW. The drive tandems, similarly to the T3-S2 vehicles, have the most significant overweight issue with 16.3 percent (22,963 of 141,349) of trucks exceeding the weight limit. After applying the one tonne tolerance to this axle group, the percentage of drive tandems exceeding the allowable weight decreases from 16 percent to 4 percent. This indicates that many of the vehicles exceeding the drive tandem weight are overweight by only a small amount (within the tolerance). Table 3 outlines the level of non-compliance at each of the four weigh stations in addition to the total for the stations combined.

The analysis of the T3-S3 vehicles revealed similar results to the T3-S2 analysis in terms of consistency. The Cañas weigh station is highlighted as having a higher percentage of overweight drive tandems. In terms of all stations, few vehicles exceed the allowable tridem axle group

weight (8 of 141,349). This could indicate an issue with load distribution within the vehicle as some vehicles exceed the drive tandem while almost none exceed the tridem axle weight limit.

Table 3 - T3-S3 Non-Compliance with Weight Regulations

| Station | N | Percent Overweight | | | |
|--|---------|--------------------|---------------|----------------|-------------|
| | | GVW | Steering Axle | Drive Tandem | Rear Tridem |
| Búfalo (East-near Atlantic ports) | 82,623 | 0.19 | 0.11 | 14.57 (3.25*) | 0 |
| Cañas (North-near border) | 9,786 | 1.22 | 0.13 | 34.02 (11.15*) | 0 |
| Villa Briceño (South-near border) | 3,719 | 1.69 | 0.22 | 10.86 (3.52*) | 0.03 |
| Ochomogo (Central-near San Jose) | 45,221 | 0.37 | 0.24 | 15.91 (3.45*) | 0.01 |
| Total | 141,349 | 0.36 | 0.16 | 16.25 (3.87*) | 0.01 |

* Percentage of overweight drive tandem axle groups after applying one tonne tolerance.

Figure 5 demonstrates the cumulative weight distribution for the T3-S3 vehicle classification. The figure shows that some vehicles exceed the allowable drive tandem axle group weight (16.3 percent or 22,963 of 141,349). After applying the one tonne tolerance; however, far fewer vehicles exceed the weight regulation (4 percent or 5,467 of 141,349).

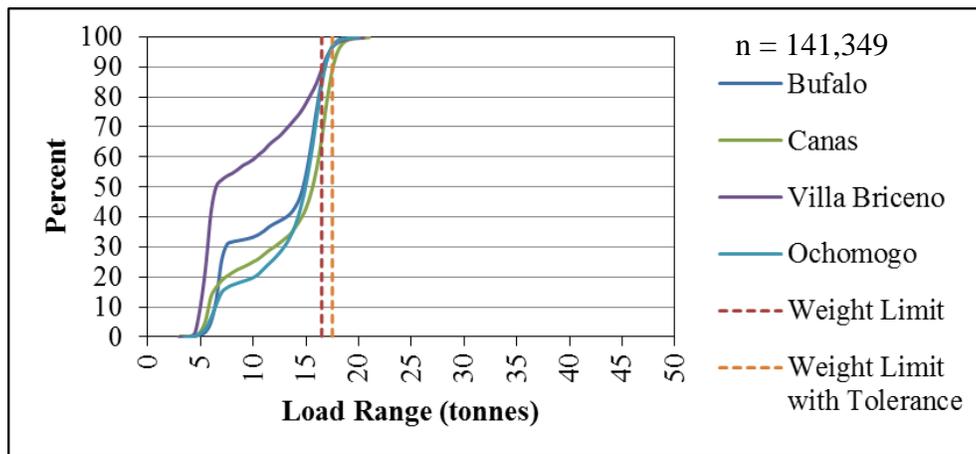


Figure 5 - T3-S3 Cumulative Weight Distribution for Drive Tandem Axle Group

Figure 6 demonstrates the cumulative weight distribution for the GVW of the T3-S3 vehicles. The figure shows that nearly all vehicles comply with the country's weight regulations for this type of vehicle.

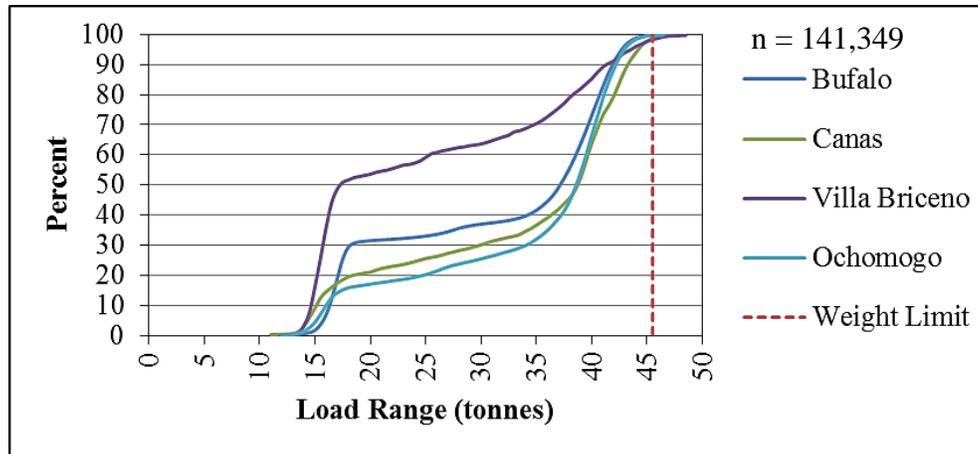


Figure 6 - T3-S3 Cumulative Weight Distribution for GVW

3.4 Discussion of Analysis Results

Two primary items are discussed with respect to the truck weight data analysis: (1) the magnitude and significance of the current compliance with weight regulations in the country, and (2) the utilization and productivity trends of trucks based on the weigh station data results.

Compliance Issues

After incorporating tolerances on the most problematic axle groups in each configuration, overall, the percentage of overweight axle groups reduces significantly. There are very few large trucks operating above allowable GVW limits on Costa Rica's highways at the locations of the weigh stations. Furthermore, the vehicles that do exceed allowable weights on any given axle group do so by a small margin or within the allowable tolerance provided in the truck weight regulations. Although this may be the case, there are still existing issues in regards to truck size and weight enforcement and more so with the enforcement of safety regulations. It is possible for trucks to by-pass weigh scales if there is no police enforcement present and the percentage of those apprehended and fined for exceeding weight limits is minimal. The mechanical fitness of the fleet and driver regulations are other areas of concern in regards to safety regulations.

Truck Productivity

When considering T3-S2s, the cumulative distribution graphs (Figures 3 and 4) reveal that with respect to weight, approximately 50 percent of vehicles are fully loaded, 35 percent empty, and the remaining partially loaded. There may be opportunities to increase the productivity of truck trips in Costa Rica and the surrounding region to decrease the percentage of empty vehicles.

Figures 5 and 6 demonstrate that T3-S3s have more pronounced trends with respect to fully loaded and empty vehicles when compared to T3-S2s. Villa Briceno is represented by a different curve shape than those formed from the other weigh stations having around 50 percent empty vehicles. The other stations show higher percentages of fully loaded vehicles and fewer empty vehicles when compared to the T3-S2 distribution. From Figures 5 and 6 it can be seen that many vehicles take advantage of the increased weight benefits associated with operating a tridem axle group. These vehicles are likely specifically chosen for these benefits and for the specific commodities they haul. This vehicle configuration was commonly observed operating with a flat deck body style (82 of 247) or carrying 40 foot containers near the ports (53 of 247).

4. Conclusions

Truck size, weight, and safety regulations are of great importance to any country. They define the types of vehicles that may operate on roadways, protect infrastructure investment, increase productivity of goods movement, and provide a safer environment for all road users among others. It is for these reasons that it is important to understand the current operating characteristics of the fleet to better address concerns in regards to the compliance and enforcement of regulations in the unique environment of Costa Rica and surrounding regions. Costa Rica's economy is dependent on the movement of freight into, out of, and through the country, similar to many other countries. Because of this, it is essential that the freight is moved in an efficient and safe manner.

The control and regulation of truck size and weight on public roads in Costa Rica is the responsibility of the Department of Transportation (MOPT). The MOPT operates four weigh stations throughout the country; however, officials at the scales do not have the authority to enforce regulations as this is the responsibility of the National Transit Police. Although there is disconnect between those that create regulations and those that enforce regulations the problem of overweight trucks in the country is small. An analysis of weight data from the stations resulting in over one million truck records revealed that few trucks are operating overweight on any one axle group or on GVW.

There may be few trucks operating overweight but many more may be operating with mechanical fitness problems. These issues can also not be addressed at the weigh stations without the presence of the National Transit Police. There are no roadside safety inspections or enforcement programs for trucks in Costa Rica at this time. Costa Rica does have a nationally implemented program requiring the inspection of all vehicles. This inspection program suffers from two key limitations with respect to large vehicles: (1) it does not capture all trailers operating in the country, and (2) day to day operations of vehicles are often not reflected during a scheduled vehicle inspection.

Costa Rica would likely benefit from a roadside safety inspection program for large vehicles, as well as from a restructuring on roles and responsibilities with respect to truck size and weight enforcement.

5. Acknowledgements

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