INFRASTRUCTURE FOR SAFETY AND COMPETITIVENESS

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ABSTRACT

Competitiveness can be defined as the capacity to offer to the clients the better satisfaction at the lowest price, keeping the market share of companies or countries.

As we know using bigger economies of scale we can lower transportation costs of the products, talking about the trucking industry this can be obtained using larger vehicles and carrying more weight.

The vehicle weight plus load weight are downloaded on the road surface, this gross weight is distributed along the number of axles. The impact that causes this weight in the road infrastructure can be diminished as the number of axles is increasing as well as using new technologies that allow a better interaction vehicle-road surface.

Using vehicles configurations -tractor plus two trailers- has been given great benefits to our country, this is the more friendly configuration with environment because its emissions in tonnes per kilometre travelled are lower, this can be explained since it consumes less fuel with load, as well as empty because it can return two trailers to its destination at once, besides its emissions reduction has also reductions in transportation cost which can be translated by offering a lower price to the final consumer.

1. FOREWORD

The Asociación Nacional de Transporte Privado (ANTP/ National Private Transport Association) from its beginning has been searching be propositive, working with its more than 120 companies associated to improve competitiveness in freight transport by all modes, participating and collaborating actively with several entities like authorities and government, in national high impact issues for this sector, having as principles social responsibility, safety, environment and economic development of Mexico.

Been part of an active society, ANTP collaborates with ideas, opinions, críticism and its gestion capacity to promote competitiveness in transport logistics to achieve a better country. To define the importance of ANTP, its neccesary say that companies associated represents one fleet of 40.000 trucks, an average of 2.5 trailers per truck, and 150,000 vehicles dedicated to urban freight distribution.

2. SAFETY IN FREIGHT TRANSPORT

As a first step of this paper, we want to start with safety, because it is one or the subjects with high priority within ANTP. In México, in contrast with other countries, this issue has the importance to be treated as a social security theme, because of the annual rate of people deaths in our roads by car accidents.

In Mexico, during year 2008 happened 496,814 deaths by car accidents, a rate of 16 deaths by each 100,000 inhabitants, which represents a cost of $121,461,817,008 millions of Mexican pesos [1] (Secretariado Técnico del Consejo Nacional para la Prevención de Accidentes, 2010).

For twelve years, ANTP have developed and been working with a national safety committee created with companies associated, with the goal of certificate their processes, searching for best practices and areas of opportunity for improvements. Nowadays 14 companies are working actively in the certification process.

We also call to all companies, associated or not, to propose drivers for a national safety award, where the prizes are given to the drivers that obtained the best results after an evaluation on safety issues

ANTP is searching to collaborate with government and non government organizations, as the Consejo Nacional para la Prevención de Accidentes / National Council to Prevent Accidents (CONAPRA), to know what are they doing and share with them the best practices.

During the last certification process, we found that several companies can improve the document where the driver report his hours of service. This process is very important, since companies can identify how many hours their personnel is dedicated to drive the vehicle, to rest, and verifying the accomplishment of the government requirements. The main purpose is to reduce the accidents relate to fatigue. At the end of the certification process, companies that have the best practices identified for the fulfilment of this report, where invited to share them with rest of the committee.

Inside the ANTP national safety committee, 42 companies worked in accidents analysis, concluding with the result that the tractor-semitrailer-trailer configuration (TSR), obtained the lowest rate of accidents, they are driving an average of 2.493 millions of kilometers before an accident occurs, significantly less than other vehicles configurations as tractor-semitrailer (TS), and straight truck (C), see Figure 1

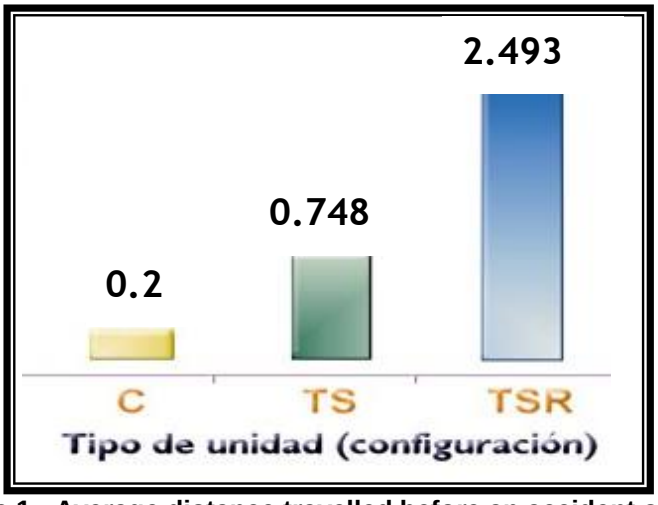


Figure 1 - Average distance travelled before an accident occurs (millions of kilometers)
Source: ANTP

Analysis and practical experiences with longer combination vehicles, on roads where is permissible, have concluded that their safety performance it is not having bigger rates of

accidents than the rest of the vehicles with less length. If we include the weight of the cargo, results in the index of accidents per tons-kilometer are even lower.

Most of the studies related to the potential impact of longer combination vehicles, it is been established that the risk by collision by kilometer travelled is the same as the rest of the vehicles. The manoeuvre and stability, included on most of collision risk of long vehicle combinations have better performance than the rest of the vehicles used today by most of motor carriers. Table 1 shows statistics related to road accidents, never the less the tractor-semitrailer-trailer configuration (T3-S2-R4) has been involved in 3% more accidents than the configuration tractor-semitrailer (T3-S2, T3-S3) and 14% less than straight trucks (C2, C3), the consequences in terms of deaths are 38% and 46% lower, respective to the other configurations and the injuries are 31% and 59% lower, respectively [2] (Gutiérrez, 2009).

Table 1 - Statistics related to road accidents of trucking industry

Configuración	Número de vehículos de carga accidentados	Resultados de vehículos de carga accidentados				
		Muertos	Lesionados	Vehiculos involucrados por 1000 accidentes	Muertos por 1000 accidentes	Lesionados por 1000 accidentes
C2, C3	2715	334	2464	1669	123	908
T3-S2, T3-S3	1648	178	877	1432	108	532
T3-S2-R4	557	37	204	1474	66	366

Source: Instituto Mexicano del Transporte [2]

As shown in Table 2 tractor-semitrailer-trailer configuration (T3-S2-R4) has a bigger capacity to brake per tons carried, and a bigger contact area with road because of the number of tires.

Table 2 - Break capacity per vehicle combination

Tipo Vehículo	Peso total	Num balatas	Ton / balata	Ton / llanta
T3S2R4	80	18	4.44	2.35
T3S3	54	12	4.50	2.45
T3S2	46.5	10	4.65	2.58

Source: ANTP

2.1 ANTP National Safety Committee

In ANTP, we are working to convert transport in a profession, since last year we are certifying companies who have the best performances in safety based on the next subjects:

- Accidents per kilometers travelled
- Report of the location of road accidents
- Report of accident causes and solutions
- Maintenance of vehicles
- Technological innovations applied to vehicle safety and its operation
- Records of Hours of service

- Health program for drivers
- Anti-Drug program
- Courses and lesson programs directed to drivers
- Driver licenses

Additionally, we recognize the operators whom demonstrate the best performance in the operation of vehicles and their theoretical knowledge, ANTP highlights the work done by drivers who have not had accidents, as an example of this level of excellence, last year we awarded to a driver that has 39 years working without accidents.

3. REGULATION FOR ROAD FREIGHT TRANSPORT

Associated companies to ANTP are complying with maintenance processes of their vehicles, exceeding the requirements of the authority in the NOM-068-SCT-2-2000 [3] in the inspection and approval of the physical and mechanical conditions to been able to use federal highways, proof of this is that companies are receiving the approval for self-regulation as a verification unit, which has allowed companies to reduce costs by carrying out the process to approve the conditions of vehicles internally, eliminating additional costs and time due to send the vehicle to a verification unit of third party.

Our associates have the best technology applied to the vehicle (tractors and trailers), because of that, they have accomplished the requirements by SCT on NOM-012-SCT-2-2008 [4] to use federal highways with the maximum weight as:

- Physical and mechanics approval and low emissions inspections for vehicles
- Motor horse power
- Auxiliar motor brake, brake retarder, or brake free of friction
- Dolly converter with double safety chain
- Anti-Lock Brake System
- Air suspension
- Engine torque;
- Capacity of traction axles

Additionally, companies are required to meet other safety elements, for example, to respect the maximum speed of 80 km/h or indicated on the signal, and a maximum length depending on the type of vehicle.

4. ANALISIS FOR DEVELOPMENT OF INFRAESTRUCTURE

The infrastructure serving to transport is a factor that influences the mobility of transport modes, and the accessibility to markets and hence competitiveness.

We have identified the following needs in Mexico:

4.1 Upgrade of road sections with high transit and low specifications

Companies have been able to use smaller roads classifications as long as they have connectivity permits according to NOM-012-SCT-2-2008 [4]. SCT has the record of the permits have been authorized in accordance with this rule, which can be used to identify road sections that require upgrading.

4.2 Toll reduction on roads, unfeasible to be paid by the user because of the high price.

There is a study of elasticity of demand that show the benefits offered by the highway considering operating costs versus the savings to be gained by comparing the cost that is generated on free roads, and thereby establish the optimum fee for each type of vehicle. However, these methods are not always successful in the case of private transport for road freight, as it has been found that the companies which are able to pay a fee, the decisions to use a toll road is made by the logistics personnel and not the driver, and consultancy firms that are responsible for doing the field studies, apply the surveys to drivers, whom can not take any decision. Thus, we have asked to concessionaires of toll roads to work on discount schemes to companies with high use of its highways.

4.3 Promote and encourage the development of logistics infrastructure that benefits the freight transportation in normal operating situations and emergencies.

The highway infrastructure should facilitate the mobility of people and freight, at any time, but especially when natural disasters occur, as may be necessary to leave the people or get them emergency supplies. From the devastating consequences in the last year in our country for the impact of cyclones and other weather phenomena, road freight transport experienced several crashes and breaks on the roads in northeast and southeast of the country. In this situation, ANTP was working with the government to seek to resolve the shortage of basic necessities and other needs of the affected population. We are now working on developing a logistics contingency plan before the closure of roads by weather conditions, identifying the areas and roads likely to be affected by these phenomena and alternate routes.

On the issue of weight and size limit allowed in the country's roads, in other countries that had remained passive, are now turning to increase their weights and dimensions. United States currently has a proposal for reform in the federal weight limit known as "Safe and Efficient Transportation Act (SETA), which has been submitted to Congress in that country, the proposal promotes the modernization of the transport standard country carriers and protecting the environment, in addition to giving producers more competitiveness.

The current weight limit in the United States is 80,000 pounds (36,287 kg) and was established 30 years ago in 1982, this weight causes it to miss a significant space in the vehicles, which translates into more vehicles, more fuel and distance to bring products to market.

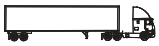
The SETA will allow each State to consider increasing the weight limit for vehicles equipped with an additional axle, allowing taking up a weight limit of 97,000 pounds (43,998 kg), which would apply only to vehicles with six-axles instead of the typical five-axles.

A study of Maine Department found that the State could have saved between $ 1.7 and $ 2.3 million a year by reducing the repairs to the pavement if trucks of 100.000 pounds (45.359 kg) to be allowed to circulate in the system interstate highway, that currently has a limit of 80,000 pounds (36,287 kg) [5] (Michaud, 2011)

Tractor-Semitrailer-Trailer (T3-S2-R4) is the configuration that has lower impact on road infrastructure, because has less download per tire to the pavement. Table 3 shows the current condition of the load transferred to road in tons per tire, according to its Gross

Vehicle Weight (GVW). As noted, the vehicles that produce less damage to the roads are Tractor-Semitrailer-Trailer.

Table 3 - Load transferred to road in tons per tire

	Peso bruto vehicular en toneladas			
	Peso bruto vehicular Diferenciado	Descarga por llanta, con PBV Diferenciado	Peso bruto vehicular Estándar	Descarga por llanta, con PBV Estándar
 Camión C2 (2 ejes, 6 llantas)	19.0	3.167	17.5	2.917
 Autobus de pasajeros B2 (2 ejes, 6 llantas)	19.0	3.167	17.5	2.917
 T3-S2 (5 ejes, 18 llantas)	46.5	2.583	41.5	2.310
 T3-S2-R4 (9 ejes, 34 llantas)	80.0	2.353	66.5	1.956

Source: ANTP

Tractor-Semitrailer-Trailer configuration T3-S2-R4 (full) is what causes less damage to the environment, it has the least amount of pollutants emitted into the atmosphere per ton/kilometer travelled, this is because it consumes less fuel to move cargo and also carries two empty trailers in one trip to his regular destination.

Table 4 shows an example where is needed to transport 10,000 tons, but in this case do not reach the maximum weight allowed, as it occupies the total volume capacity of the trailers before being limited by weight. Thus, according to the performance of vehicle settings, to move the same amount of tons of product, when using semi-trailer trucks ("single") it is consumed 46% more fuel, compared with the use of vehicles with Tractor-Semitrailer-Trailer ("full").

Table 4 - Litters of fuel consumed fuel by vehicle configuration

	Toneladas a transportar	Viajes totales	Longitud viaje	Rendimiento	Litros consumidos
Full 80.0 ton	10.000	182	500	1,76	**51.705**
Sencillo 46.5 ton	10.000	317	500	2,10	**75.476**

Source: ANTP

Following the previous example, when migrating from full to single, it creates a higher cost of transportation, which, when passing the profit margin set by companies, affects the final price of products purchased by the consumer, which can be seen on Table 5.

Table 5 - Cost per vehicle configuration (in Mexican pesos)

Configuración	NOM-012-SCT-2-2008				
	PBV(Ton.)	Ton. a transportar	Viajes totales	Costo	
				$	%
Doble tailler(Full) con tecnología	80	10.000	182	1.382.181,8	0,0
Sencillo T3-S2 con tecnología	46,5	10.000	317	1.759.682,5	0,0
Impacto por cambiar de configuración			-136	-377.500,7	27,3

Source: ANTP

Mexican Transportation Institute (Instituto Mexicano del Transporte IMT) has also shown that the tractor-semitrailer-trailer ("full" T3-S2-R4) is more competitive in terms of wear of the pavement, as shown in Figure 2 the vehicles that deteriorate less roads and lower the maintenance costs of roads to the country, are tractor-semitrailer-trailer carrying 80 tons.

CONFIGURACIÓN	Centavos de USD (aproximados)
FULL T3-S2-R4	0.65
C2	1.45
B2	1.45
T3-S2	0.95
T3-S3	0.85

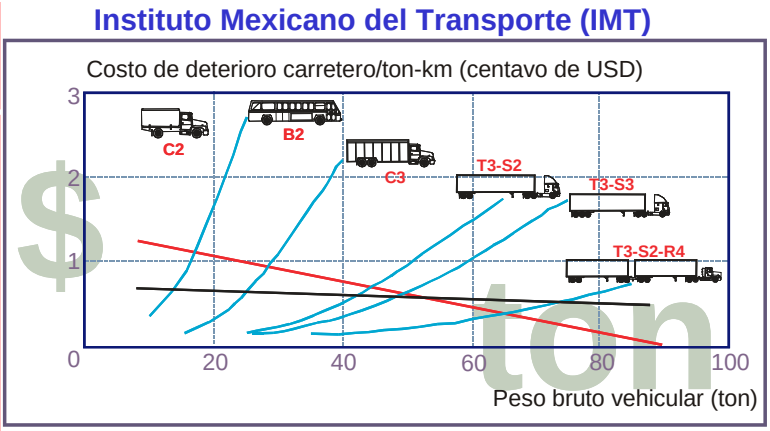


Figure 2 - Costs of road maintenance
Source: Instituto Mexicano del Transporte [6]

Internationally there have been studies to identify potential improvements in effective terms for increased road safety and environmental regulation for trucks, with better systems for implementation of regulations, and identify opportunities for greater efficiency and higher productivity. In particular, it has been informed of the authorizations for extensive use of long combination vehicles. This is currently under consideration in many countries because of the potential of these vehicles to achieve greater productivity results [7] (OECD / International Transport Forum, 2010), here are the description of the current status of these improvements

- Several countries in Northern Europe are testing European Modular Vehicles, which is a family of vehicles composed of combinations of standard trailer with length limits of 25.25 meters and weight limits of 60 tons.
- The state of Victoria, Australia, began testing a family of trucks with lengths range from 30 m and weight limits of 77.5 tons in 2009.

- The province of Ontario, Canada, approved a limited number of permits in 2009 to test more combinations of vehicles, tractors capable of carrying two trailers larger, weighing up to 63.5 tons and a length of 40 meters.
- Currently under discussion in the U.S. the possibility of increasing the length and weight of trucks in interstate traffic, where the weight limit is 36.3 tons and the maximum length of the vehicle combination established by Federal law and state programs.

On the issue of implementing higher-capacity vehicles internationally include the following studies which demonstrate the potential to improve fuel efficiency and reduce pollutant emissions [7] (OECD / International Transport Forum, 2010):

- A study in Sweden in 2008, where greater capacity vehicles have been allowed for many years, considered the impact of restricting the types of vehicles to those authorized by the European Union for international exchange. This study found that the cost per trip per vehicle would be reduced between five and twelve percent, depending on the product, but the number of trucks required to transport the same amount of charge would increase by 35 to 50 percent. On average 1.37 truck size allowed by the European Union would be required to replace a truck with the largest dimensions allowed in Sweden.

- A Canadian study in 2001 found that the use of simple configurations with tractor-semitrailer in Alberta, instead of using larger configurations, leading to a 80% increase in travel costs, resulting in an increase of 40 % in carriers that use large configurations. From a standpoint of economic efficiency and social benefit, this becomes a gain in efficiency of transport costs with a greater reduction in fuel consumption, reducing emissions of greenhouse gases and a wide reduction in pavement wear.

- In Australia, the combination of tractor with semitrailer and trailer, 26 feet long and weighing 68.5 tons, was introduced in 1984. For 2006, Australia had 69,600 articulated trucks, of which 11.400 were tractor with semitrailer and trailer. Under conservative assumptions, it is estimated that if Australia had not allowed the use of double trailers, an additional of 6.700 articulated trucks would have been required to move the same amount of cargo. A recent estimation of 2008, makes reducing the use of vehicles between 15.000 and 20.000. With the use of double trailers are estimated to have reduced the fuel consumed by the articulated fleet by 11%.

Table 6 shows with data from an associated company of ANTP, that transportation costs are increased by 31%, as downloaded tons per million of kilometers traveled in a T3-S2 configuration (single) compared with T3-S2-R4 configuration (full), which leads to the conclusion that the full has more competitive operating costs and produce less damage to road infrastructure.

What we want to note is that the gross vehicle weight is not a direct relationship to the road wear, because it is transferred through the axles, and the tires transfer it through their area in contact with the pavement. A greater number of axles, tires, and contact surface, the pressure will be less, a vehicle that can carry more tons of freight, is not necessarily synonymous of increased wear of the pavement.

It is noted that by having more wheels, for this example the distance that rolls the total of tires is 3% higher in the case of T3-S2-R4 compared with T3-S2 (28,968 vs. 28,166),

however, when is calculated the downloaded tons per million of kilometers traveled, so that it can approve the information to be comparable, the T3-S2 moves 10.7 tons more per million of kilometers traveled, compared with T3-S2-R4.

Table 6 - Competitive advantages for T3-S2-R4 and T3-S2 (costs in Mexican pesos)

a. Venta Artículos Promedio Diario: 12000
b. km recorridos por viaje: 142
c. Número de días al año: 365

Concepto	Configuación Vehicular T3-S2-R4	T3-S2
d. Capacidad de carga de articulos [artículos]	2,000	1,120
e. Viajes diarios necesarios (a)/(d) [viajes]	6	11
f. Distancia recorrida diaria por total de viajes necesarios (b)*(e) [km]	852	1,562
g. Costos de operación por km recorrido en ruta [$/km]	$14	$10
h. Costo km diarios (f)*(g) [$]	$11,928	$15,620
i. Costo Anual (c)*(h) [$]	**$4,353,720**	**$5,701,300**
Reducción en Costo Anual por empleo de T3-S2-R4	**$1,347,580**	
j. Número de llantas [llantas]	34	18
k. Recorrido total sumatoria de todas las llantas de viajes diarios (j)*(f) [km]	28,968	28,116
l. Pesos máximos autorizados NOM-012-SCT-2-2008 [ton]	80	46.5
m. Descarga del peso en pavimento por llanta (l)/(j) [ton]	2.353	2.583
n. Toneladas descargadas en un millón de kilómetros recorridos (m)/(k)*10^6	81.2	91.9
o. Reducción toneladas descargadas por millón de km recorridos empleando T3-S2-R4	**10.7**	

Source: ANTP

Figure 3 and Figure 4 can further explain the above example, suppose that the way they do in all the tires for each vehicle configuration, is represented by a single tire that covers 28,968 km in the case of T3-S2-R4 and 28,166 km in the case of T3-S2. The tire in the case of T3-S2-R4 carry a weight of 2,353 tons, and in the case of T3-S2 carries 2,583 tons, if we distribute those weights on each kilometer driven respectively by the tire that represents each vehicle configuration and multiply per million, we note that the T3-S2-R4 download 81.2 tons and T3-S2 download 91.9 tons per million of kilometers driven.

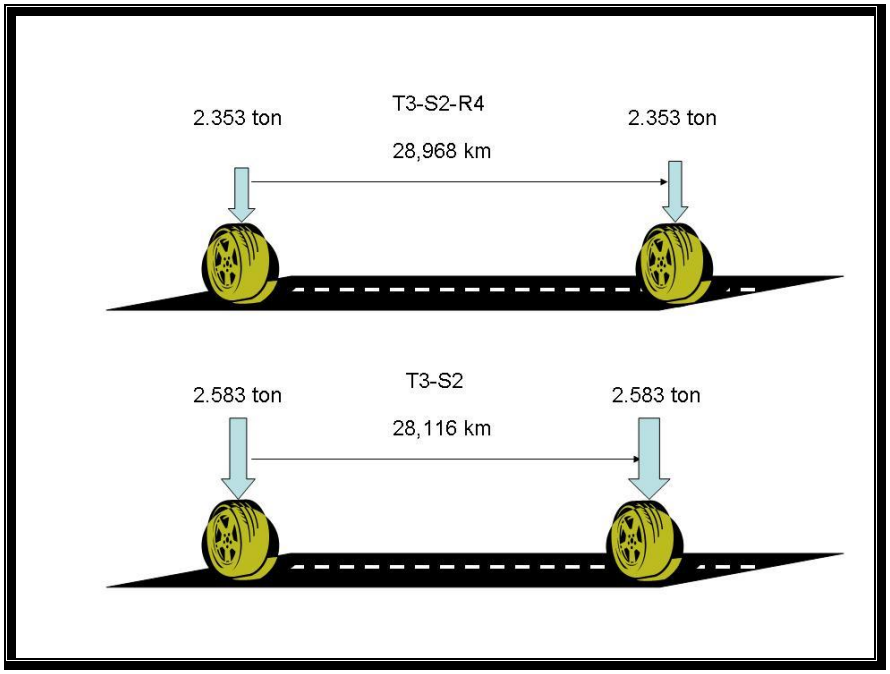


Figure 3 - Download and distances travelled by T3-S2-R4 and T3-S2
Source: ANTP

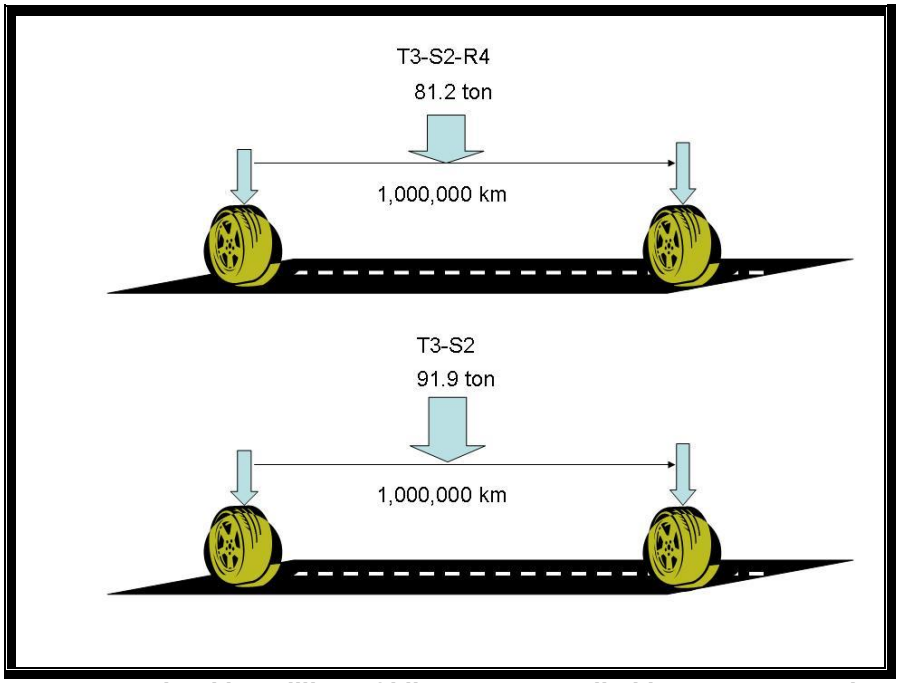


Figure 4 - Download by million of kilometers travelled by T3-S2-R4 and T3-S2
Source: ANTP

4.4 Consider logistics reserve areas within the urban development plans of the entities.

For several years there have been several initiatives in some states around the restriction of freight transport in roads or local areas, most of them have not obtained the expected results, since it can not been taken unilateral decisions without first studying and solving issues related to environment, logistics, operations and economics. Moreover, to improve their product distribution processes, companies have made use of distribution centers located near major consumption centers, an important factor in defining whether they are correctly positioned, there is easy access to destinations, this can be obtained according

to the rank of road connectivity, so the logistical development of these areas should be reserved with a preference for this use.

5. CONCLUSIONS

Throughout this document were technically presented case studies of associated companies of ANTP and international studies, the attributes, benefits and competitive advantages for the interests of road safety, such as reducing operating costs, conservation of road carpet with the lowest deterioration, and reduced environmental impact with the use of tractor-semitrailer-trailer, compared to other vehicle configurations, hoping to be a reference to reduce the constraints that exist and those seeking to engage in federal, state, municipal and local highways, in our country.

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