Adoption of UN Regulations and Consumer Information Systems Will Bring Improvements to Vehicle Safety Standards in Latin America and the Caribbean:

Final Report of the Regional Public Goods (RPG) Project

Transport Division

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Alejandro Furas
Juan Ramos
Kavi Bhalla
Nicolás Garrido
Edgar Zamora (editor)

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Final Report of the Regional Public Goods (RPG) Project

IDB
Inter-American Development Bank

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Acronyms

(ABS)	Anti-Lock Braking System
(AC.1)	Administrative Committee of the 1958 Agreement
(ACAU)	Automotive Trade Association of Uruguay
(ADEFA)	Argentine Vehicle Manufacturers' Association
(AFAC)	Argentine Automotive Components Association
(LAC)	Latin America and the Caribbean
(AMIA)	Mexican Automotive Industry Association
(ANAC)	Chile National Automotive Association
(ANDEMOS)	Colombian Association of Motor Vehicles
(ANFAVEA)	Associação Nacional dos Fabricantes de Veículos Automotores de Brasil
(ASCOMA)	Uruguay Automotive Dealers and Manufacturers Association
(ASEAN)	Association of Southeast Asian Nation
(IDB)	Inter-American Development Bank
(RPG)	Regional Public Goods Project
(CAT)	Certificate of Conformity with the Legislation
(EC)	European Commission
(ECLAC)	Economic Commission for Latin America and the Caribbean
(UNECE)	United Nations Economic Commission for Europe (UNECE)
(CMVSS)	Canadian Motor Vehicle Safety Standards
(CNTSV)	Argentine National Commission for Traffic and Road Safety
(CONTRAN)	Conselho Nacional de Metrologia de Trânsito de Brasil
(COP)	Conformity of Production
(CRA)	Comparative Risk Assessment
(DALYs)	Disability-adjusted Life Years
(DENATRAN)	Departamento Nacional de Trânsito de Brasil
(ECOSOC)	United Nations Economic and Social Council
(EPA)	United States Environmental Protection Agency
(EU)	European Union
(Euro NCAP)	European New Car Assessment Programme
(FHWA)	Federal Higway Administration
(FMVSS)	Federal Motor Vehicle Safety Standards
(GBD)	Global Burden of Disease
(GR)	Groupes des Rapporteurs del WP.29
(GTR)	Global Technical Regulation
(IDEAM)	Colombia Institute of Hydrology, Meteorology and Environmental
(IHME)	Institute for Health Metrics and Evaluation
(IIHS)	Insurance Institute for Highway Safety
(ILAC)	International Laboratory Accreditation Cooperation
(INEC)	National Institute of Statistics and Census of Ecuador
(INEGI)	National Institute of Statistics and Geography of Mexico
(IPEA)	Instituto de Pesquisa Econômica Aplicada de Brasil
(IRAM)	Argentine Institute of Normalization and Certification
(ISO)	International Standardization Organization
(IWVTA)	International Whole Vehicle Type Approval
(KMVSS)	Korea Motor Vehicle Safety Standards
(LATCH)	Lower Anchors and Tethers for Children

(Latin NCAP)	Latin New Car Assessment Programme for Latin America and the Caribbean
(MERCOSUR)	Southern Common Market
(MIPRO)	Ministry of Industry and Productivity of Ecuador
(MRA)	Mutual recognition agreements
(MTOP)	Ministry of Transport and Public Works of Uruguay
(NCAP)	New Car Assesment Programme
(NEDC)	New European Driving Cycle
(NHTSA)	National Highway Traffic Safety Administration
(NOM)	Official Mexican Standards
(OECD)	Organisation for Economic Co-operation and Development
(SDGs)	Sustainable Development Goals
(OICA)	International Organization of Motor Vehicle Manufacturers
(OLA)	United Nations Office of Legal Affairs
(WHO)	World Health Organization
(NGOs)	Non-Governmental Organizations
(UN)	United Nations
(GDP)	Gross Domestic Product
(REIO)	Regional Economic Integration Organizations
(CRS)	Child Restraint System
(SRRV)	Japan Safety Regulations for Road Vehicles
(SUV)	Sport Utility Vehicle
(TAA)	Type-Approval Authorities
(EU)	European Union
(UNECE)	United Nations Economic Commission for Europe
(UNESCAP)	United Nations Economic and Social Commission for Asia and the Pacific
(VIN)	Vehicle Identification Number
(WHO)	World Health Organization
(WP.29)	UNECE World Forum for Harmonization of Vehicle Regulations
(WP.29/AC.2)	Administrative Committee for the Coordination of Work of the World Forum WP.29

EXECUTIVE SUMMARY

1. Context

Road safety is one of the major challenges faced by humanity as we continue to develop and urbanize as a species. Approximately, 1.3 million people die in road crashes every year, and an estimated 50 million suffer physical injuries[1]. In the Latin America and Caribbean (LAC) region, the annual road traffic death rate is 19.2 per 100,000, more than twice the rate found in mature economies[2].

To address this situation, in 2010 the United Nations adopted an action plan known as the "Global Plan for the Decade of Action for Road Safety 2011-2020", with the goal of stabilizing and then reducing the number of road traffic fatalities and casualties. The Global Plan is based on the implementation of five pillars that were identified as essential to road safety. The third pillar of the action plan is about safer vehicles, and it states the following: "Encourage universal deployment of improved vehicle safety technologies for both passive and active safety through a combination of harmonization of relevant global standards, consumer information schemes and incentives to accelerate the uptake of new technologies". Among the activities recommended to pursue this pillar, the following is included: "*Encourage Member States to apply and promulgate motor vehicle safety regulations as developed by the United Nation's World Forum for the Harmonization of Vehicle Regulations (WP 29[3])*" and encourages countries to implement new car assessment programs in order to increase the availability of consumer information about the safety performance of motor vehicles.

Vehicles in the region are not currently sufficiently safe, both in preventing or mitigating the dangerous effects of road crashes including severe injuries and fatalities. The purpose of different innovations in road safety is to lower traffic crashes rates, and reduce the severity of these crashes in order to bring down the number of fatalities and serious injuries. Carrying out a study on vehicle's technical characteristics through performance evaluations can establish each automobile's level of protection or safety.

2. Regional Public Goods Project

The Regional Public Goods (RPG) initiative with regard to the "Support for the implementation of vehicle regulation standards in Latin America and the Caribbean" is a project that was developed with technical and financial support from the Inter-American Development Bank (IDB). This study was created as a response to the express request made by regional countries regarding the need to address vehicle safety as a key element of road safety, taking into account the poor results achieved in the vehicle safety assessments of passenger cars and the high fatality rate in the LAC region. This study analyzes a list of seventeen (17) UN Regulations on vehicle safety and emissions that were selected by the beneficiary countries.

The RPG aims to analyze the regulatory frameworks of the countries concerned, propose adjustments to those frameworks and provide tools and strategies to regional governments to address vehicle safety and emissions.

[1] *Global Burden of Disease* of the Institute of Health Metrics and Evaluation, University of Washington.

[2] Road Safety in the Region of the Americas. Pan American Health Organization, 2016.

[3] The abbreviation WP.29 is used for the World Forum for Harmonization of Vehicle Regulations. WP.29 is a permanent working party in the United Nations Economic Commission for Europe that administers three UN Agreements on motor vehicles; in particular, the 1958 Agreement concerning the approval of vehicles, its parts and equipment and the reciprocal recognition of approvals granted in accordance with UN Regulations annexed to the 1958 Agreement. All UN countries may participate fully in the activities of the World Forum. Those countries that are Contracting Parties to the Agreement have voting rights. The rest have a voice, but no voting rights. Governmental and non-governmental organizations recognized by the UN may also participate in a consultative capacity in the activities of the WP.29.

The RPG focuses on small passenger vehicles[4], as specified in categories M_1 and N_1 derived from M_1, although several of the recommendations are also applicable to larger vehicles. Countries included in this study are Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay. However, the report has been developed so that its recommendations may also apply to the entire region. The RPG report consists of three multidisciplinary and interconnected sections.

The first section of this study, developed by the Latin New Car Assessment Program for Latin America and the Caribbean (Latin NCAP), conducts a thorough analysis of the existing regulations in each of the six RPG signatory countries, produces a regulatory proposal for an efficient application, analyzes how the approval process should be conducted and generates support tools for the governments to implement these processes. These recommendations are meant to be carried out in each country. Technical and operational factors are taken into account for the successful adoption of effective regulations, contributing to substantial reductions in the number of road fatalities and injuries through the improvement of road safety.

The second section of this study, led by the University of Chicago, focuses on analyzing the overall health impacts of the proposed regulations including lives saved, disabilities avoided and other benefits.

Finally, the third section of the study, carried out under the supervision of the Economic Commission for Latin America and the Caribbean (ECLAC), analyzes economic impacts in terms of income, employment, commercial exchange and fiscal implications in LAC countries, as a result of the possible adoption of the selected UN Regulations.

[4] M_1: Vehicles intended for the transport of passengers up to 9 seats including the driver. N_1: Cargo vehicles with an authorized maximum of 3,500 kg. M_{1a}: Passenger vehicles adapted for loading up to 3,500 kg. M_{1b}: Cargo vehicles adapted for passengers up to 3,500 kg.

One of the main goals of the RPG project is to generate reflection about the adoption of standards for vehicles via two high-level policy dialogues. The first Regional Workshop was carried out during the month of August 2018 in Mexico City, where a space was created to discuss vehicle safety in the region; to offer a joint vision of the methodologies and preliminary results of the research carried out; and to generate facilitate discussion and feedback between the technicians and other regional government officials.

As a follow up to the 1st Regional Workshop, the 2nd Regional Workshop was carried out in Washington DC in November 2018, with the following goals:

- To present the results and findings of the three studies of the RPG project;
- To provide continuity to dialogue conducted by LAC countries and the research teams, in order to encourage the adoption of a minimum set of UN Regulations developed by WP.29, as well as other effective measures to strengthen market mechanisms such as the Latin NCAP star rating.

Representatives of about twenty LAC countries attended both regional workshops, including the six countries that are signatories to the RPG.

A summary of the work carried out in the three sections of the study is presented below, including the main results and findings.

3. The automotive market in Latin America and the Caribbean

The automotive market in Latin America is characterized by two large vehicle manufacturing countries and a significant heterogeneity of standards and government controls, as well as vehicle types and models. The regional market has three large car manufacturers, although two of them are located in the same market: Argentina and Brazil (MERCOSUR), and, besides them, Mexico. The Brazilian market is the largest of the three in volume, with up to 2.5 million units produced in 2018, followed by Mexico with 1.4 million and then Argentina, with 803,000 cars.

The Mexican market exports to many other markets in the world. In fact, some brands produce models in Mexico that are not produced elsewhere and are meant for export all around the world complying with the most strict safety and emission standards. This fact demonstrates that the Mexican industry has the potential to meet the strictist standards from a technical point of view. Its commercial agreements with other markets help sustain this condition in the long term. On the other hand, Brazil and Argentina are manufacturers focused on the domestic market and hardly export to countries outside Latin America (except certain models), and thus, the local industry has focused more on local regulations and requirements.

4. Regulatory framework recommendations and changes in technical standards

Latin NCAP has proven that passenger cars sold in the region of Latin America have lower safety standards, even though they look the same as those models sold in countries with mature economies. The main recommendation is to make compulsory the approval of vehicles and components as regards the agreed 17 UN Regulations. In addition, federal standards equivalent to those in the United States of America (FMVSS) and Canada (CMVSS) were considered for vehicles produced in these countries, which could also be accepted under a set of conditions to verify their compliance.

The assessment of each country's regulatory framework leads to a recommendation to improve the corresponding regulations and the development of a digital platform to support governments in verifying and implementing vehicle type-approvals.

The type-approval of vehicles in conformity with the 17 UN Regulations annexed to the 1958 Agreement would be a mandatory requirement for the registration of nationally manufactured vehicles as well as for vehicles assembled or imported in each and every country of the LAC region. This recommendation does not only apply to the six countries participating in this study (signatory to the RPG), but its application is recommended in every country in the region. The UN Regulations proposed and developed by WP.29 under the umbrella of the 1958 Agreement guarantee that the Contracting Parties have control on compliance with said UN Regulations and can conduct verification every 2 years within a framework of independent testing and assessment carried out by the manufacturer at no cost to the Contracting parties. From a commercial point of view, the 1958 Agreement promotes the harmonization of regulations in order to eliminate technical barriers to trade. The mutual recognition of type-approvals by the Contracting Parties promotes the acceptance of mutual approvals immediately. If the countries of the LAC region were Contracting Parties to the 1958 Agreement of WP.29, their approval certificates would be accepted without question and they would be globally endorsed by other Contracting Parties.

Table 1. List of UN Regulations referred to in the RPG project

Safety-related UN Regulations	
1. UN R13H - Braking of passenger cars category M_1 and N_1	7. UN R140 - Electronic Stability Control (ESC) Systems
2. UN R14 - Safety-belt anchorages	8. UN R 145 - ISOFIX anchorage systems
3. UN R16 - Safety-belts	9. UN R17 - Strength of seats, their anchorages and head restraints

4. UN R25 - Approval of head restraints	10. UN R32 - Behavior of the vehicle in a rear-end collision
5. UN R94 - Protection of the occupants in the event of a frontal collision	11. UN R95 - Protection of the occupants in the event of a lateral collision
6. UN R 135 - Protection in the event of a pole side impact	12. UN R127 - Pedestrian Safety
Environment-related UN Regulations	
13. UN R83 - Emissions of M_1 and N_1 vehicles	14. UN R101 - CO_2 emission and fuel consumption
15. UN R103 - Replacement pollution control devices	
UN Regulations related to Child Restraint Systems	
16. UN R44 - Child Restraint Systems	17. UN R 129 - Enhanced Child Restraint Systems

In general terms, from the analysis carried out concerning the six participating countries (Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay), we can conclude the following:

a) None of the countries has signed (is a Contracting Party to) the 1958 UN Agreement;
b) Some of these countries not only are not Contracting Parties, but they have opted to apply the UN Regulations annexed to the 1958 Agreement only partially and with modifications, combined with national standards. And, in most cases, these countries lack proper certifications and controls;
c) The concept of "vehicle type-approval" is recognized by all governments, although its implementation and control is lacking measures that guarantee the thorough compliance with the specified regulations and technical aspects;
d) The so-called approval or authorization process is carried out on the basis of a documentation review, without a physical inspection of vehicles. This should be considered a weakness in the approval system, since the authorization to import and register vehicles is granted based only soley on documentation and not a physical inspection;
e) Approval of the vehicle, part or system is not required. Only a test report issued by a laboratory is requested, which is just one step of the approval process. In some cases, the laboratory must be accredited, but not always. In certain cases, the laboratories are different from the ones designated by the approval authorities of the countries that are Contracting Parties to the 1958 Agreement, and therefore, do not comply with the mandatory requirements set forth in Annex 3 of the Agreement for the laboratories. They also do not refer to the part or model in question, but to another one of a similar model;
f) Conformity of production is not verified, and therefore it is not possible to verify that the vehicles put on the market actually comply with mandatory regulations;
g) Drafting national regulations requires great effort in terms of technical and human resources. The national application of the UN Regulations annexed to the 1958 Agreement could simplify the lawmaking process thus reducing time as well as the risk of introducing outdated content and technology in local regulations. Moreover, the UN Regulations have been widely discussed and validated by governments and the industry worldwide, and they have proved efficient in the markets that have been applying them for over 50 years;
h) Some national regulations require specific technologies such as airbags, ABS or three-point belts, but their performance or technical characteristics are not

specified. For example, a safety belt may be installed, but it may not offer the necessary protection for passengers in the event of a collision. However, the UN Regulations specify what each safety element must do, for example "prevent certain injuries to the occupants", and thus, do not exclude the possibility that a different technology may fulfil that same function in the future. UN Regulations indicate what each particular technology must achieve without specifying how the technology is produced or obtained;

i) No country clearly indicates the set of amendments (or versions) to which they refer in their national regulations when they mention the UN Regulations and, in many cases, they may be applying outdated versions of said regulations;

j) These countries have developed regulations and standards that seek to emulate or copy UN Regulations or other international standards; however, they are incomplete, as sentences related to specific requirements have been removed, clearly undermining the original purpose of the UN Regulations;

k) For the countries of the region, any standardization body recognized by ISO can certify the compliance with the corresponding safety regulation accepted in each country; that is to say, MERCOSUR standards, American standards (FMVSS), UN Regulations annexed to the 1958 Agreement and Brazilian regulations among others. ISO does not ensure or specify the detailed procedures to verify the compliance with the proposed standards which would require, impact tests or specific tests. ISO does not specify how the verification process should be conducted or the penalties for not complying with the UN Regulations. ISO certifies processes or bodies, but not specific regulations such as the UN Regulations, which can only be certified by the Contracting Parties to the 1958 Agreement;

l) In most of the cases analyzed, the critical sections of local regulations and standards are established by consensus between industry and government, without civil society taking part in the process. That is to say, if the industry does not approve a specific measure, it will be removed from the proposed regulation. In countries with efficient and effective vehicle safety, regulatory power is exercised only by governments after prior consultation with both industry and civil society (as done by WP.29). In the framework of WP.29, the opinion of the industry and consumers is considered, but the final vote on a UN Regulation is a government decision alone. Government votes will take the perspective of industry and consumers into account.

m) As a contribution on the part of the RPG project to these countries, Chapter 3 of the first section of this document proposes a generic national regulatory document that requires vehicles, systems and parts to comply with at least "type-approval" requirements in the 17 UN Regulations listed above. The type-approval certificate in accordance with the 1958 Agreement of the UN WP.29 can only be issued by a Contracting Party to the 1958 Agreement applying the respective UN Regulation. This means that the governments of the Contracting Parties are responsible for signing and issuing these certificates. In general, the signatory is a high national authority of a given country and, before signing the certificate, this government will ensure full compliance with the regulation since signing a certificate in case of non-compliance may result in problems with other Contracting Parties, and the approval granted may even be revoked.

n) In order to issue such an important certificate, governments must ensure compliance with the requirements by requiring further testing and/or analyzing the production lines for vehicles or parts. Governments should also consider adopting the regulations in the Federal Motor Vehicle Safety Standards (FMVSS) and the Canadian Motor Vehicle Safety Standards (CMVSS) to comply with standards in the United States and Canada respectively.These regulations should be applied in all countries of the region and not only in the countries that manufacture the vehicles.

5. Potential positive health impacts

There is strong evidence that improvements in vehicle design achieved significant reductions in the probability of road traffic deaths and injuries in mature, Western economies. These improvements were the result of two specific efforts: i) establishing regulations requiring vehicles to meet a basic minimum safety threshold; and ii) market competition, measured by a star-rating system carried out by the New Car Assessment Programs (NCAPs), which created an incentive for manufacturers to develop substantially better designs than those that only meet minimum requirements. While it is not possible to separate the contribution of these two efforts in improving safety, this study estimated how many lives would be saved as well as the disability burden averted in each country covered by the study, and in the whole region if vehicle safety technologies were adopted.

The vehicle safety technologies evaluated in this study are: i) Anti-Lock Braking Systems (ABS); ii) Electronic Stability Controls (ESC); iii) frontal airbags; iv) side airbags; v) seat belts; vi) side door beams; vii) side paddings; viii) head restraints and ix) frontal vehicle design for pedestrian protection. The technologies analyzed in the RPG report must comply with the technical requirements proposed by WP.29.

The UN Regulations provide the technical standards that a safety component must meet in order to work effectively. For example, a vehicle may have ABS, but it may not be able to fulfil the task for which these brakes were designed under certain driving conditions. UN standards also technically determine what parameters technologies must meet in order to protect effectively. An airbag can be an "inflatable bag" but if, for example, it is too rigid when inflated, it can injure the passenger or, if it does not have enough pressure, it may not protect him. UN regulations describe the behavior that each technology in the vehicle must accomplish.

Data from the University of Chicago indicates that minimum safety standards have been met in markets such as Europe, the USA, Australia and Japan. However, in these same markets most of the vehicle models produced in the last 10 years have also achieved 4- and 5-star ratings in local NCAP tests that exceed the minimum standards required in those markets. Consequently, the majority of cars on the road exceed the basic requirements of UN Regulations. It is not possible to separate the figures regarding fatalities and injuries from the impact of 4- and 5-star vehicles. Perhaps if these markets had settled for vehicles that barely met the minimum requirements set by UN Regulations without exceeding them, the number of fatalities and injuries would be higher. For example, even though the ESC was not mandatory for over 10 years, it was still standard equipment on most models in Europe and the USA.

Likewise, side airbags that protect the upper body and head have been standard equipment for over 10 years, but they are not mandatory in UN. Furthermore, side impact protection standards were not in place before 2018, when they became mandatory, despite the fact that, for the last 10 years, head protecting side airbags were standard equipment on all models on the market by a voluntary decision made by manufacturers in order to meet the NCAP 4- and 5-star standards.

This analysis uses estimates of the relative risk of death and injury that have been derived from assessments of actual road traffic crashes involving vehicles with and without these technologies, together with estimates of the current prevalence of technologies in LAC countries, in order to estimate annual deaths and injuries in the alternative scenarios where the prevalence of technology was raised to 100%.

The key finding of this analysis is that the safety technologies commonly used in the USA and Europe would have a major impact in reducing the number of deaths and injuries in the LAC region (refer to **Figure 1**). The following are examples of the benefits of adopting these technologies under UN Regulations in LAC countries:

a) Thanks to the effect of the ESC (including the effects of ABS), 10,000 to 37,000 less deaths per year would be achieved with a general estimate of 22,800 (19%) fewer deaths in the region;
b) It was also noted that safety belts are a highly-effective technology for protecting passengers, and that they are available in almost all vehicles in the region, but their use remains low. Increased safety-belt use would lead to an estimated reduction of 11,000 to 18,000 deaths per year, with a general estimate of 14,200 (12.1%) fewer fatalities in the region;
c) Regarding the increased availability of frontal airbags, which are effective in complementing safety belts in frontal impacts, this could allow for a reduction of 2,700 to 5,100 annual deaths, with a general estimate of 4,100 (3.5%) fewer fatalities in the LAC region.

Side airbags that include head protection are the most important element to mitigate deaths and injuries in cases of side impacts, and the region could eliminate between 2,500 and 4,000 deaths per year, with a general estimate of 3,300 (3%) fewer deaths due to the increasing availability of side airbags.

It should be noted that, the frontal design of the vehicle is especially important for pedestrian protection because pedestrians represent a large proportion of fatalities in many countries. The Latin American and the Caribbean region would experience a reduction of between 4,400 and 7,300 deaths, with a general estimate of 7,100 (6.0%) fewer deaths per year, by increasing the availability of vehicles designed for pedestrian protection.

In case of a total adoption of the technologies analyzed, the potential overall reduction for the of deaths in the LAC region is estimated at 33,000 (28%).

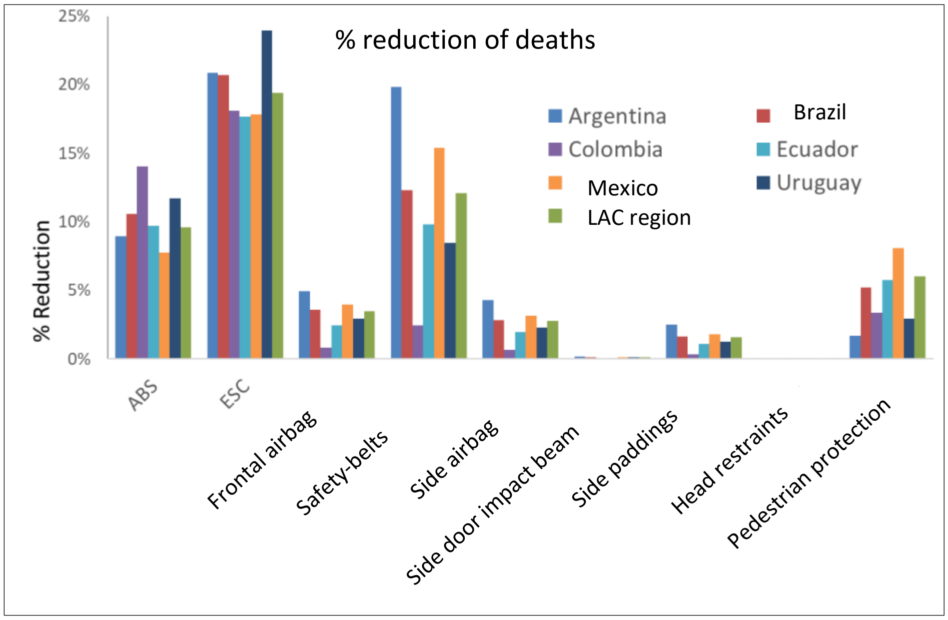


Figure 1. Comparison of the potential of different technologies on total road traffic fatalities in selected countries and the LAC

On the other hand, it is important to note that NCAP programs can lead manufacturers to develop designs that provide safety measures that go beyond the minimum requirements set by regulations. For example, this analysis shows that the LAC region would experience a much greater reduction in side impact fatalities (7,400 deaths) if mechanisms like NCAP were used to encourage manufacturers to adopt the best vehicle designs available in the region.

Similarly, there are likely to be major benefits in vehicle design in order to ensure that several technologies and other design features work together as a system in frontal impact configurations as well as other types of impacts.

6. Potential economic impacts

The use of vehicles for transportation has dramatically changed the structure of everyday life in the LAC region. On the one hand, vehicles have led to an increase in productivity with regard to the transportation of people and goods, while, on the other hand, they have contributed to a series of undesired outcomes like premature deaths in road crashes or problems associated with respiratory diseases caused by pollution.

This study analyzes the potential effects on the economies of Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay, which are the countries that have the most developed vehicle and auto parts manufacturing sectors in Latin America. If these economies implemented the Vehicle Regulations (WP.29) incorporating technologies that reduce the probability of fatalities and morbidity associated with traffic crashes.

The method used to measure the economic impact developed in this study, assumes two general mechanisms that show how the technological improvements recommended would translate into larger changes for the economy.

On the one hand, it is assumed that the introduction of these new technological elements would reduce the damage caused by car crashes, generating savings in household health costs. These savings would be allocated to the consumption of non-health-related goods, investments and improvements in people's education. On the other hand, when technologies produced throughout the region are harmonized, changes in intra- and extra-regional trade would occur, generating positive effects on all economies. These two channels are analyzed systemically in what is known as a "general equilibrium model"[5].

Following this evaluation, and based on the assumptions on which the model is built, it is estimated that the implementation of these safety technologies recommended in the UN Regulations developed by WP.29 would yield the following results:

a) In the most likely scenario, these technologies would generate regional economic growth of 0.79% of GDP with different effects for each country, according to the structural and foreign trade characteristics present in each;
b) The expected growth in Argentina would be approximately 1.04% of the GDP. In the best scenario, the country could generate as much as 1.9%, while in a more conservative scenario it could grow 0.7%. Brazil is expected to grow 1.02%, in the best case scenario it could grow as much as 1.9% and in the worst case 0.7%. Colombia could grow 0.63% in the baseline scenario, 1.6% in the best case scenario and 0.5% in the worst. Ecuador would have an expected growth of 0.61%, 0.4% in the worst case and 1.3% in the best case. Mexico could grow 0.5%, in the best case scenario it would grow 1.2% and in the worst scenario 0.4%. Finally, Uruguay would have an expected growth of 0.59%, in the best scenario 1.7% and in the worst 0.4%. The effects on the countries that are part of this study depend on their structural characteristics. The case of Mexico is noteworthy, due to the fact that, despite being the region's largest vehicle manufacturer and having the largest manufacturer industry by contribution to GDP among Latin American countries, it is the country with the lowest expected growth due to the relatively low trade interaction with the rest of the Latin American countries;
c) The public administrations of these countries would increase their profits thanks to the increased activity, which would exceed the expenses incurred to generate it. There is virtually no cost for the administrations to issue the Conformity of Production Certificate and the type-approval certificate granted by the Contracting Parties to the 1958 Agreement; however, the study shows that it could generate economic growth between 0.2% and 0.7% of GDP;
d) While it is possible that some sectors will benefit more than others as a result of the implementation of the UN Regulations, it should be noted that employment growth would likely vary between 0.25% for Uruguay and a maximum of 1.05% for Mexico. This result suggests that the welfare of workers' households should not be affected in the medium term.

In general, the results of the economic impact analysis conducted shows that improving safety technology enhances economic conditions in all countries in the region. The well-being of the entire population increases as more households have better access to public goods offered by their economies. The life expectancy of the entire population would increase across the region. Economic growth also increases thanks to the effect that the improvement of people’s health has on their production capacity. Households increase their savings in order to plan for a longer

[5] A general equilibrium model takes into account the relationship between all relevent markets, their links and interrelations. When the price of a specific good or element changes, the effect it has on the corresponding market must be taken into consideration, as well as the effects it has on related markets in terms of prices and quantities. This way, the connection of all the related effects can be followed through the interaction of markets.

life and this in turn generates a greater income for the whole economy.

Countries would benefit from updating regulations to incorporate the right technologies into their fleets. Administrations must visualize the most efficient and effective strategies to update their fleets and take advantage of the benefits these offer for competitive development of the industrial sectors. Economic policy instruments must be properly organized. On the one hand, updating fleets must be accelerated by changing consumer preferences and altering user incentives. On the other hand, appropriate industrial policies must be developed.

Modifying consumer preferences for safer and cleaner cars helps speed up the adoption of superior technology. Vehicle evaluation programs, such as Latin NCAP, play an important role in this process of changing consumer preferences, making the relevant information accessible to all consumers.

However, in low- and middle-income countries in the LAC region, consumers are very sensitive to price changes. So manufacturers can still find large market segments where they can sell vehicles equipped with lower-performance technologies for lower prices. The corresponding authorities could therefore also consider regulating insurance companies to support adopting new technologies by incentivizing changing insurance prices. These changes could offset any new expenses to households in the cost of vehicles.

Aligning regional homologation standards with a set of international standards offers the possibility of creating joint industrial policies between the private sector and the state, for the development of a world-class auto-parts supply sector. The development of industrial policies to achieve these objectives is an opportunity that should be considered for the entire region, rather than individually for each country.

Lastly, countries must face many challenges to update these technologies, but the potential growth opportunities for regional economies make it worthwhile to embark on the necessary effort to do so. These market benefits are in addition and relation to the health benefits also summarized above.

PART I.

UN VEHICLE REGULATORY SYSTEM & PROPOSALS TO COUNTRIES

Introduction to Part 1

The first section of this study provides a detailed review of the technical regulations framework applicable to vehicle safety as well as an analysis of existing local regulations in each of the six RPG signatory countries. A regulatory text is also proposed for the efficient application of the UN Regulations to support countries that wish to implement it.

In addition, vehicle type-approval control processes, based on the UN Regulations, are explained in detail. To support its implementation, this section also outlines a computer platform developed within the framework of the RPG for the documentation and approval process.

This section of the study will end with a presentation of the new car assessment programs (known as NCAPs) and their role in transforming the market as well as their impact via consumer information programs.

The technical information gathered in this section of the study serves as the basis for analyzing the potential impacts of vehicle safety improvements on public health and the economies of the LAC region, to be further developed in the second and third sections of this report.

CHAPTER I-1. Background on UN Technical Regulations on Vehicle Safety and Emissions

I-1.1 World Forum for Harmonization of Vehicle Regulations (WP.29)

The following is a summarized text of the publication "*WP.29 – How it Works, how to join it*"[6]

WP.29 is a Working Party within the United Nations Economic Commission for Europe's Inland Transport Committee. It was established in 1952 as the "Working Party on the Construction of Vehicles". It was initially set up to develop technical regulations for vehicles in the ECE countries and to facilitate international trade by eliminating technical barriers to trade. In 1996, the scope of the UN Vehicle Agreements was extended to all member countries within the UN system. In 2000, WP.29 changed its name and became the "World Forum for Harmonization of Vehicle Regulations (WP.29)" but kept its original acronym WP.29 (see organizational chart below in **Figure 2**).

Its role and that of its subsidiary Working Parties is to develop new UN Regulations, new UN Global Technical Regulations (GTRs), new UN Rules, harmonize existing UN Regulations, and amend and update current UN Regulations, UN GTRs and UN Rules that address the areas of concern covered by the Agreements that the WP.29 administers. In the framework of technical inspections of vehicles, WP.29 develops UN Rules to harmonize vehicle inspections of already registered vehicles.

The UN agreements administered by the WP.29 are the following three:

a) **1958 Agreement.** Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions, signed in Geneva on 20 March 1958. This Agreement is known as the 1958 Agreement. On 14 September 2017, revision 3 of this Agreement entered into force.

b) **1997 Agreement.** Agreement concerning the adoption of uniform conditions for periodical technical inspections of wheeled vehicles and the reciprocal recognition of such inspections, signed in Vienna on 13 November 1997.

c) **1998 Agreement.** Agreement concerning the establishment of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles, signed in Geneva on 25 June 1998.

This study focuses on the activities of WP.29 concerning the 1958 UN Agreement, and to some extent the 1998 Agreement regarding the global technical regulations that have an equivalent in the UN Regulations annexed to the 1958 Agreement.

WP.29 fosters worldwide participation in its activities by encouraging cooperation and collaboration between countries and regional economic integration organizations with regard to technical matters that come before it and before its Working Parties. WP.29 also encourages open and transparent dialogue between government regulators, other technical experts competent in the field of technical requirements for vehicles, and the general public in order to ensure that best safety and environmental practices are adopted and economic implications are taken into account in the development of UN Regulations. The meetings of WP.29 are public. Any government and any other interested party may attend and observe the proceedings of the meetings.

[6] Available at: http://www.unece.org/index.php?id=51355&L=0

Participation of governments

Any country member of the United Nations, and any Regional Economic Integration Organization (REIO) set up by member countries of the United Nations may participate fully or in a consultative capacity in the activities of WP.29 and become a Contracting Party to the Agreements administered by WP.29.

Participation of Non-Governmental Organizations (ONGs)

In accordance with Rule 1 of the Terms of Reference and Rules of Procedure, non-governmental organizations (NGOs) may participate in a consultative capacity in WP.29. In order for an NGO to participate in WP.29, it must first be accredited a consultative status to ECOSOC - the Economic and Social Council of the United Nations.

NGOs are substantive contributors to the process of developing UN wheeled vehicle safety, environmental, energy and anti-theft regulations. They are often called upon for technical data and advice.

Subsidiary bodies of WP.29 responsible for the different UN regulations

Proposals to WP.29 for new UN Regulations and amendments to existing UN Regulations are referred by WP.29 to its subsidiary bodies for the preparation of technical recommendations. Each subsidiary body consists of experts in a relevant area covered by the body. The work of the subsidiary bodies has proven so indispensable that they have been given permanent status under the UNECE and, in turn, have been renamed "Working Parties". There are currently six Working Parties subsidiary to WP.29. In order to observe tradition and to maintain continuity concerning the titles of these subsidiary bodies, the abbreviation "GR" (coming from the time of "*Groupes des Rapporteurs*" and the names of those Groups in the French language) is kept in the acronyms of the Working Parties and in the symbols of their working documents. The following table shows the structure of the Working Parties.

Table 2. Structure of the Working Parties of WP.29 until June 2018

Responsible for Active Safety:	Working Party on Lighting and Light-Signalling (GRE);
	Working Party on Automated/Autonomous and Connected Vehicles (GRVA)
Responsible for Passive Safety:	Working Party on Passive Safety (GRSP);
Responsible for Environment Protection:	Working Party on Pollution and Energy (GRPE);
	Working Party on Noise and Tyres (GRB);
Responsible for General Safety Questions including Public Service Vehicles:	Working Party on General Safety Provisions (GRSG);
Special Technical Issues:	Informal working group(s) which are formed by, and report their work to one of the established Working Parties subsidiary to WP.29 or directly to WP.29.

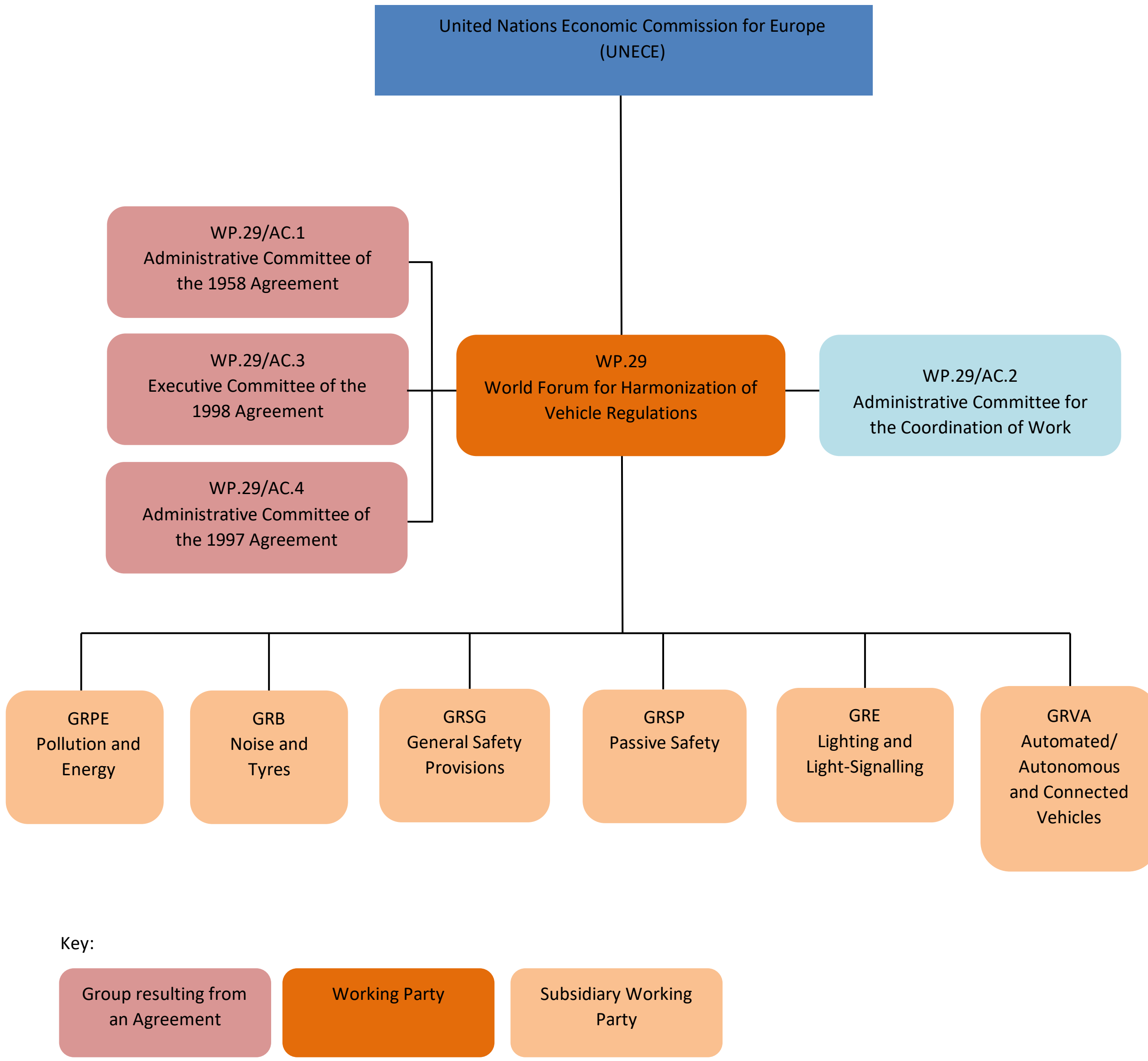


Figure 2. Permanent Organization of WP.29 from June 2018

I-1.2 The 1958 Geneva Agreement

As indicated above, this Agreement[7] refers to the 1958 UN Agreement signed in Geneva and is known as the 1958 Agreement.

The 1958 Agreement was reached on 20 March 1958, entered into force on 20 June 1959, amended on 10 November 1967, and revised on 16 October 1995. On 14 September 2017, Revision 3 of this Agreement entered into force and it is the only version currently in force. The Agreement provides

[7] Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions, signed in Geneva on 20 March 1958.

procedures for establishing uniform prescriptions about new motor vehicles and motor vehicle equipment and for reciprocal acceptance of approvals issued under UN Regulations annexed to this Agreement. UN Regulations adopted by Contracting Parties to the 1958 Agreement pursuant to the Agreement govern the approval of motor vehicles and motor vehicle equipment for sale in those countries. The Agreement addresses safety requirements, environmental (air and noise pollution emission), energy and anti-theft prescriptions. With the entry into force of Revision 3 of the Agreement, the concept of International Whole Vehicle Type Approval, known as IWVTA, was introduced. The text of the 1958 Agreement is available on the World Forum WP.29 website at: http://www.unece.org/trans/main/wp29/wp29regs.html

The 1958 Agreement provides the legal and administrative framework for establishing UN Regulations (annexed to the Agreement) with provisions for testing vehicles, equipment and parts, which are oriented towards their performance rather than their design. The agreement also contains administrative procedures for granting type approvals, for the conformity of production and for the mutual recognition of the type approvals granted by the Contracting Parties.

When acceding the 1958 Agreement, the new Contracting Party is not obliged to apply all the UN Regulations annexed to the Agreement that are in force at the time of accession: the new Contracting Party may choose, if any, which UN Regulation it would like to apply, and may even choose not to apply any of them.

The 1958 Agreement currently has 53 Contracting Parties (CPs), including the European Union. 41 of them are European UNECE member countries. Other Contracting Parties include Japan, Australia, South Africa, New Zealand, Republic of Korea, Malaysia, Thailand, Tunisia, Egypt and Nigeria. It should be noted that no LAC country is a Contracting Party to the 1958 Agreement.

The 1958 Agreement has 147 UN Regulations annexed to it. The UN Regulations are continuously adapted to technical progress, whenever appropriate, to take into account technical and political guidance from the Contracting Parties, the evolution of scientific knowledge and technological progress.

It is important to note that under the CARS21 program, the European Union has decided to repeal a considerable number of EU Directives and replace them with direct and mandatory applications of the equivalent UN Regulations. Pursuant to Regulation (EC) No. 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor, the European Union has repealed more than 50 European Directives and replaced them with the mandatory application of the corresponding UN Regulations for the registration of vehicles within the territory of the European Union. This study concludes that the only effective solution to the challenge of improving local regulations is for this policy to be implemented by countries in Latin America and the Caribbean.

This EU Regulation has been updated twice (Regulations EC 441/2011 and 523/2012), updating the repealed Directives. Said Regulations are available at: http://ec.europa.eu/enterprise/sectors/automotive/documents/regulations/regulation-2009-661_en.htm.

Principal Elements of 1958 Agreement

Members of the UNECE, as well as other members of the United Nations and Regional Economic Integration Organizations that participate in UNECE activities are eligible to become Contracting Parties to the 1958 Agreement. In practice, this means that all member countries of the United Nations can become Contracting Parties to the 1958 Agreement.

The 1958 Agreement seeks to establish UN Regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles, and conditions for granting type approvals and their reciprocal recognition for use by Contracting Parties who choose to implement those UN Regulations through type approval.

In addition to improving safety and emission conditions, the 1958 Agreement aims to eliminate technical barriers to trade through the type approval of vehicles, their equipment and parts and the reciprocal recognition of approvals granted.

International whole vehicle type-approval can be granted from July 2018, once the new UN Regulation No. 0 enters into force. This Regulation No. 0 includes various requirements. However, all Contracting Parties applying UN Regulation No. 0 must accept whole vehicle type-approvals which have a higher level of stringency than that CP applies.

The 1958 Agreement aims to increase the number of Contracting Parties to the agreement by improving its functioning and reliability, thus ensuring that it remains the key international framework for the harmonization of technical regulations in the automotive sector.

The Administrative Committee (AC.1) adopts new UN Regulations and amends the existing UN Regulations. The Administrative Committee is composed of all the Contracting Parties to the 1958 Agreement, which are those countries with voting rights.

Under the 1958 Agreement, new UN Regulations and amendments to existing UN Regulations are established by a vote of four-fifths majority of Contracting Parties present and voting. The new UN Regulations and amendments to existing UN Regulations adopted by the AC.1 are forwarded to the Executive Secretary of the UNECE who then notifies each Contracting Party to the Agreement of these changes.

The new UN Regulation or amendment to an existing UN Regulation enters into force for all Contracting Parties six months after the Executive Secretary of the UNECE has notified them, unless one-fifth or more of the Contracting Parties object within the aforementioned six-month period. The new UN Regulation and its amendments shall not enter into force for the Contracting Parties that have notified their objection. If more than one-fifth of the Contracting Parties object, the UN Regulation or amendment does not enter into force for any Contracting Party.

UN Regulations annexed to the 1958 Agreement are required to include performance-oriented technical requirements for vehicles and cannot include technical restrictions on their development. They include regulatory tests and alternative test methods, as appropriate, the conditions for granting type approvals and their reciprocal recognition. They must also include approval markings and conditions for ensuring Conformity of Production (COP); and the date on which the UN Regulation enters into force, including the date on which Contracting Parties applying this Regulation may issue approvals under this UN Regulation and the date from which they accept said type approvals (if different) and shall include an information document to be supplied by the manufacturer requesting the type approval.

A Contracting Party that has adopted a UN Regulation annexed to the Agreement is allowed to grant type approvals for vehicles, equipment and parts covered by that UN Regulation and is required to accept the type approval of any other Contracting Party that has adopted the same UN Regulation.

The Agreement also permits a Contracting Party, upon notice, to begin applying a UN Regulation after it has been annexed to the Agreement or to cease application of a UN Regulation that it has been applying. In the latter case the Contracting Party is required to notify the UN Secretary General of its decision one year in advance.

Contracting Parties may grant and accept type approvals in accordance with earlier versions (series of amendments) of UN Regulations. This provision allows developing economies to apply less stringent versions of the UN Regulations, until these countries decide it is possible to apply the most up-to-date version of the Regulations. All Contracting Parties must recognize and accept type approvals from, the most advanced version (series of amendments) of the UN Regulations, even if those Contracting Parties apply an older series of amendments.

Contracting Parties granting type approvals are required to have the technical competence to grant the approvals and the competence to ensure Conformity of Production. Each Contracting Party applying a UN Regulation through type approval may refuse the approvals if the abovementioned requirement is not met.

This agreement also includes Schedules of Administrative and Procedural Provisions applicable to all UN Regulations annexed to this Agreement and to all Contracting Parties applying one or more UN Regulations. Schedules are part of the Agreement and cover the following:

Schedule 1	Conformity of production procedures;
Schedule 2	Part 1. Assessment, designation and notification of technical services;
	Part 2. Standards which the technical services, referred to in Part one of this Schedule, shall comply with;
	Part 3. Procedure for the assessment of technical services;
Schedule 3	Procedures for UN type approvals;
Schedule 4	Numbering of UN type approvals;
Schedule 5	Circulation of UN type approval documentation;
Schedule 6	Procedures for resolving interpretation issues in relation to the application of UN and granting UN type approvals pursuant to these UN Regulations;
Schedule 7	Procedure for exemption of UN type approvals concerning new technologies;
Schedule 8	General conditions for virtual testing methods.

Revision 3 of the 1958 Agreement is reproduced in Annexes I-1 to I-3 of this study.

I-1.3 UN Regulations annexed to the Agreement

Main provisions of the UN Regulations annexed to the 1958 Agreement

UN Regulations annexed to the 1958 Agreement cover all categories of vehicles, i.e. mopeds, motorcycles, passenger cars, buses and coaches, trailers, agricultural vehicles and mobile or road machinery. UN Regulations annexed to the 1958 Agreement shall include:

a) Technical requirements and alternative requirements, if appropriate;
b) Test methods by which any performance requirements are to be demonstrated;
c) Conditions for granting UN type approvals;
d) Conditions for reciprocal recognition of UN type approvals granted;
e) Provisions for the marking of vehicles, equipment and parts to facilitate the Contracting Parties' control of vehicles to be registered in their countries;
f) Conditions for ensuring Conformity of Production;
g) The date on which the UN Regulation enters into force.

UN Regulations must be applied without any modification. Contracting Parties may apply earlier versions (series of amendments) of the UN Regulations, but must accept UN type approvals granted in accordance with the latest version of the UN Regulations. Contracting parties can only grant UN type approvals for the versions they apply.

Main benefits for Contracting Parties applying the UN Regulations:

a) **Enhancing vehicle safety and environmental performance**: UN Regulations are developed with the most stringent provisions for safety and environmental performance in vehicles. Acceding to the Agreements and applying the UN Regulations for the registration of vehicles will result in safer and more environmentally friendly vehicles.

b) **Compliance with the recommendations of the UN Decade of Action for Road Safety Plan:** The UN Global Action Plan for the Decade is based on five pillars[8]. The third pillar is dedicated to safer vehicles and recommends the implementation of UN Regulations developed by the World Forum WP.29 for vehicles.

c) **Mutual recognition of type approvals granted:** a Contracting Party that has decided to apply a UN Regulation annexed to the 1958 Agreement may grant type approvals for the whole vehicle, equipment and parts covered by that UN Regulation. Said Contracting Party is obliged to accept type approvals from any other Contracting Party applying the same UN Regulation. This is one of the key elements of the 1958 Agreement.

d) Elimination of technical barriers to trade through mutual recognition of the type approvals granted.

e) **Facilitating the development of national vehicle regulations**: the development of new vehicle regulations is a complex, slow and costly process. By implementing the UN Regulations, which have proven to be effective globally in those countries that apply them, countries have access to a set of vehicle regulations at no cost and whenever they need them.

f) **Flexibility in the application of UN Regulations:** when acceding to the Agreement, the Contracting Party is free to choose which UN Regulations, if any, will be applied. The Contracting

[8] See details at: https://www.who.int/roadsafety/decade_of_action/plan/spanish.pdf

Party may, at any time, apply any other UN Regulation. Any Contracting Party may decide to cease the application of any UN Regulation simply by giving one year's notice.

g) Contracting Parties may set their own priorities with regard to safety conditions and the environmental performance of vehicles, by choosing the order of application of the UN Regulations.

h) **Keeping national regulations:** UN Regulations can be optional within national regulations. Contracting Parties applying a UN Regulation can keep or derogate their national regulations.

i) **Technological development of the services of the administration**: The application of the UN Regulations will require the establishment or technical evolution of the corresponding services of national administrations in order to verify the technical conditions of vehicles prior to their national registration, as well as to verify the conformity of production of vehicles.

j) **Technological development of national manufactures:** By applying UN Regulations, national industry may improve its technological know-how to adapt the manufacturing process of vehicles, equipment and parts to the most advanced technologies in practice. As national regulations can be maintained in parallel with the UN Regulations, which is only advisable for a certain period of time, technological innovations can be integrated smoothly by national manufacturers.

k) **Participation in the decision-making process for the development of UN Regulations:** All Member States of the United Nations may participate in the development of UN Regulations. Nevertheless, only the Contracting Parties to the Agreement may vote when establishing a new UN Regulation, or when adapting a UN Regulation applied by the Contracting Party to technical progress.

l) **National Type Approvals:** National Authorities can grant Type Approvals to national manufacturers for those UN Regulations the country applies. National manufacturers can obtain a type approval for their vehicles or parts in their own country. These approvals must be recognized by the other Contracting Parties applying the same UN Regulation.

CHAPTER I-2. Diagnostic analysis of the system and regulatory framework by country

I-2.1 Introduction

The scope of this technical study is limited to vehicles of category M_1 and N_1 derived from M_1. This study focuses on the six signatory countries of this RPG (Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay). The diagnostic analysis covers two aspects: (i) analysis of the type approval system itself; and (ii) determining the the conditions under which current vehicles are permitted on the road in these same countries. These aspects have been studied using the information provided by the regulatory, approval and import authorities of each country and collected during visits to the countries and meetings with the various government officials.

In order to know the real situation in each country, the following areas have been studied:

a) Description of the regulatory process: identification of the ministries, directorates or bodies in charge of mandating the M_1 passenger vehicle standards, as well as the entity that must approve and disseminate the regulations issued, and the body responsible for monitoring compliance with the regulatory process.
b) Identification, analysis and diagnosis of the legislation or regulations, including decrees, that mandate the technical requirements for the approval, nationalization (local manufacture) and/or registration of M_1 and N_1 derived from M_1 passenger vehicles. If applicable, the regulations, laws, or higher-order rules that authorize or mandate the competent Ministry to legislate on vehicle type approval are also identified.
c) Description of how the legislation mentioned in paragraph b) is implemented, including a description of the process that must be followed to verify that the domestically produced and imported vehicle complies with the established regulations, the identification of the body responsible for carrying out implementation and application controls, and the procedure for carrying out said controls. The independent laboratory responsible for conducting the approval tests, if any, is identified together with the body to which it reports.
d) Integration of the Vehicle Type-Approval Services with customs services for imported vehicles, including the legislation and necessary documentation required for the import and clearance of vehicles.
e) The findings for each country have been classified as confidential and therefore they have not been included in this study. Only the portions of analysis corresponding to each of the officials of the six countries that have participated in this study has been disseminated.

It should be noted that all data was collected and analyzed before July 31, 2018. Any subsequent changes to legislation in the countries covered by this study have not been included and therefore, such changes have not been analyzed or incorporated into the conclusions of this study.

I-2.2 Conclusions and observations regarding the six countries included in this study

The general issues examined in this study and the findings related to the six regional countries are detailed here.

The study carried out in the six countries has confirmed that, although none are yet a Contracting Party to the 1958 UN Agreement administered by WP.29, they all have, to some degree, a system that can be called "vehicle type (model) approval", although it is not similar to the system proposed in the 1958 Agreement.

Vehicle regulation varies significantly between regional countries. Almost all regulations are based on national standards which, in theory, are based on international regulations from relevant bodies. However, it was observed that, in practice, countries accept national regulations from other countries which are quite old and are not adequate for modern safety concerns.

Even though some national regulations mention the UN Regulations annexed to the 1958 Agreement, UN Regulations have been only partially reproduced in said national regulations, eliminating some of the key parts, such as the certification layout and conformity of production. In other cases, national regulations also refer to old and outdated amendments to the UN Regulation in question and in some cases they only refer to the UN Regulation without specifying the series of amendments.

Other regulations are also accepted, the most common being those of the USA, MERCOSUR, Japan, Korea, China and Australia. In some cases, any standard developed by a standardization entity is accepted, provided that this entity is recognized by the ISO. Thus, many institutions, whether specialized in vehicle safety or not, have produced regulatory texts which can be considered as the country's "standard". A system of verification, discussion, elaboration and development of such supposed regulation is not required, which can become a potential source of technical and commercial conflict.

Basically, type approvals in the six countries are based on an analysis of the documentation submitted. In no case is the approval itself requested, but simply a test report from a laboratory certifying that the vehicle type (model) meets the requirements of the regulations in force in each country. No approval is requested, even for any of the required UN Regulations.

Laboratories performing regulatory testing are not, in most cases, accredited as the laboratories that perform the approval tests of UN Regulations annexed to the 1958 Agreement. In some cases, no conditions are imposed on the laboratories, while in others the tests carried out by the manufacturer itself are accepted. In rare cases, tests carried out by a laboratory accredited by a Contracting Party to the 1958 Agreement are submitted.

In no case is a visual inspection of the vehicle carried out to verify that the vehicle is covered by the documentation submitted for its approval.

The Conformity of Production (COP) procedure is either not carried out or is carried out in a manner not compliant with the standards established in the 1958 Agreement, although levels differ from country to country.

It should be noted that in the countries under review, there are not enough technicians and they do not have a sufficient level of knowledge to carry out the relevant checks. A fee is required for the application for approval, said fee should be calculated to cover the actual cost of the approval, including the cost of the staff required to carry it out.

In particular, the requirement for certain parts -such as requiring ABS, two frontal airbags and three-point belts- lacks definition and technical specifications, which are necessary to increase the safety of the vehicle.

With regard to ABS requirements, while it is true that it enables a more efficient braking system, the most important thing is that such efficient braking system meets certain minimum conditions, such as those specified in other national or international regulations. It is worth noting that UN Regulation No. 13-H, on braking requirements for vehicles of categories M_1 and N_1, requires compliance with certain specifications in order to obtain the type approval. This UN Regulation, which is included in the list of UN Regulations in this study, does not require vehicles to be equipped with ABS. However, if a vehicle is equipped with ABS, it must comply with the requirements of the corresponding annex to UN Regulation No. 13-H. However, in the regulations of the countries under review, no ABS verification is required, it is only necessary for it to be installed. If all M_1 and N_1 vehicles derived from N_1 are to be equipped with ABS, they should simultaneously be required to be equipped with ABS and type-approved (including ABS requirements) under UN Regulation No. 13-H.

The requirement for two frontal airbags does not necessarily ensure that the vehicle complies with regulations or is type approved regarding protection in the event of a frontal collision (UN Regulation No. 94), of a lateral collision (UN Regulation No. 95), or Pole Side Impact (UN Regulation No. 135). However, airbags alone do not ensure the protection of the occupants in the event of any of the three impacts mentioned above, it is the vehicle as a whole, its body strength and deformation, seat belts, steering wheel impact protection and airbags, among other protective mechanisms, which ultimately ensure occupant protection.

Requiring three-point belts on all seats is not a sufficient condition, as it does not, by itself, ensure the proper protection of occupants of motor vehicles. Vehicles should have been designed in such a way that belts together with their anchorages can withstand any possible impact when it occurs. Both the safety belts and their anchorages should be type-approved under UN Regulations No. 14 and 16 in their latest series of amendments to ensure proper protection of the occupants.

This type of partial implementation of standards can be found in relation to any UN regulation and not only the ones listed above.

References to a UN Regulation in general are not quite accurate. These should be clearly defined to which series of amendments they refer. In fact, the difference in safety requirements between the first version and the latest version in force of UN Regulations is so large that the safety offered to the occupants is completely different. For instance, the first version of UN Regulation 16 (safety belts) (also known as the 00 series of amendments) came into force in 1970 and the last series of amendments (07) came into force in 2017. If compliance with a specific and recent series of amendments is not required, there is a risk that vehicles and their equipment will meet requirements that are more than 30 years old. This dynamic applies to all the relevant UN Regulations, although the time difference between regulations is not always so large. In any case, requirements need only refer to "the most recent series of amendments for which a model was certified in any market in the world which is a Contracting Party to the 1958 Agreement".

Furthermore, developing national rules and regulations that are similar to the UN Regulations but not quite as complete, requires considerable human and material resources. Considering that most UN Regulations have been translated into Spanish and Portuguese by the European Commission and are available in the Official Journal of the EU, the development of national rules and regulations requiring a significant investment of time and resources seems unnecessary as it could just be established that all vehicles must obtain type-approval under the corresponding UN regulations to the latest level of amendments in force. This is one of the objectives of this technical-economic study. This would simplify the regulatory process, avoid technical errors when drawing up national rules and regulations and facilitate the conformity of imported or domestically manufactured (assembled) vehicles with the corresponding UN Regulation, thanks to the type-approval certificate and the information regarding said type-approval available in both the test report and the documentation submitted by the manufacturer.

The fact that any standardizsation body recognized by ISO can certify the compliance of vehicles with the corresponding safety standard for the standards that are accepted, i.e. MERCOSUR, FMVSS, UN Regulations annexed to the 1958 Agreement and Brazilian standards, cannot ensure that vehicles meet the most recent and demanding safety criteria. First, the above-mentioned standards are not equivalent. Therefore, the safety of a vehicle approved and registered in the same month may provide different levels of protection depending on which standard it has been tested against. It could easily happen that two citizens registering a vehicle at the same time are offered a very different level of protection by national legislation. Furthermore, even though the certification procedure is carried out by ISO-recognized laboratories, it is possible that such laboratories may not specialize in the field of vehicle safety. In addition, a vehicle bought by a citizen which meets FMVSS requirements has not had proper production control, so some units may be more likely to be faulty or fail to comply with regulation than vehicles covered by UN Regulations.

The procedure used for the approval of a vehicle under a particular UN Regulation ensures better compliance with the requirements of a given set of amendments to that UN Regulation. In fact, before granting a type-approval, the authority responsible for granting said approval must verify that the manufacturer's quality system is adequate. Secondly, approval tests may only be performed by technical services (laboratories) designated by the authority responsible for granting approvals, which will verify that the laboratory has the necessary means, staff and experience required to carry out such tests. Lastly, before granting the type-approval, the competent approval authority shall verify that the technical service has carried out the tests correctly. Finally, conformity of production shall be verified to ensure that the manufacturer continues to produce vehicles that match the same specifications as the one used to obtain the type-approval. In addition, once a vehicle is approved, a Type-Approval Certificate signed by the competent authority is issued, containing sufficient information to verify that vehicles submitted for national approval conform to the type-approved. A test report from the technical service designated by the approval authority may also be required, containing additional technical information for testing the vehicle to be approved and for checking the conformity of production of imported vehicles covered by that type-approval.

Despite the importance of carrying out such checks and controls, none of the six countries reviewed in this study carry them out. They all limit themselves to carrying out a documentary check.

Finally, the table below shows a comparison between the six countries with regard to the most important elements included in this study, including the UN Regulations proposed for mandatory application in the region.

Obviously, those countries which apply more regulations than those mentioned in this study should continue to do so, although it is recommended that the implemented regulations be replaced by the approvals of the respective UN Regulations with the appropriate type approval certificates signed by a Contracting Party to the 1958 Agreement.

Table 3. Assessment overview for the six countries[9]

Item	Argentina	Brazil	Colombia	Ecuador	Mexico	Uruguay
Parts of the 1958 Agreement	NO	NO	NO	NO	NO	NO
Type-approval system similar to that of the 1958 Agreement	NO	NO	NO	NO	NO	NO
National "approval/reception or other system" for registration	YES	YES	YES	YES	YES	YES
Required documentation	Test report	Test report	Test report	Test report	Test report	
Issuance of a national type-approval certificate	YES	YES	YES	YES	YES	YES
Verification of the test certificate issued by a laboratory	YES	YES	YES	YES	YES	YES
Conditions for test laboratories	Any	Level 1: Declaration of conformity Level 2: Unaccredited Laboratory Level 3: Management system and technical capacity or accredited by ILAC	National or countries of origin	Designated	Recognized in the vehicle's country of origin	
Physical inspection of the vehicle together with documentation	NO	NO	NO	NO	Random, without tests	
Control of conformity of production	NO	NO	NO	NO	NO	

[9] Blank cells mean that specific information was not provided.

Item	Argentina	Brazil	Colombia	Ecuador	Mexico	Uruguay
Existence of national testing laboratories	NO safety YES emissions	NO	NO	National emissions laboratory	Emissions	
National laboratories perform tests	Emissions only one per thousand and only for domestic vehicles	NO	NO	NO	NO	
Requirement for approval with regard to UN Regulations	NO	NO	NO	NO	NO	NO
Other accepted regulation/rules	FMVSS, IRAM (Argentine Normalization and Certification Institute), MERCOSUR, Directive	Only national	Only national	National, American, Chinese, Australian, Korean, Japanese and Brazilian	NMX, NOM, FMVSS, EU, SRRV KMVSS, CONTRAN	UN, USA and any standard set by an ISO-recognized body
Safety regulation related to the corresponding UN Regulation						
UN R14 - Safety-Belt Anchorage Systems and Child Restraint Anchorage Systems	Rev.3 CRS Rev.6 - 04			Series of amendments not indicated	Series of amendments not indicated	Not indicated
UN R 145 - ISOFIX anchorage systems	NO			NO	NO	NO

Item	Argentina	Brazil	Colombia	Ecuador	Mexico	Uruguay
UN R16 - Safety belts	Revision 4 means that in general for safety belts the requested legislation is Revision 4 of the UN Regulation No. 16, with the following exceptions: For the alert when the driver (only the driver and not the passenger) is not using the safety belt the provisions are those specified in Revision 5 of the UN Regulation. For retractors applies Revision 05 For Child Restraint systems the 04 series of amendments For the 3-point rear seat Revision 4 For the rest of retractors, the 00 series of amendments			Series of amendments not indicated Audible warning when not in use	Supplement 10, no series of amendments indicated, use reminder	Obligatory, unspecifed

Item	Argentina	Brazil	Colombia	Ecuador	Mexico	Uruguay
UN R17 – Strength of Seats, Anchorages, and Head Restraints	Rev.5			YES	Series of amendments not indicated	NO
UN R94 - Occupant Protection in Frontal Collisions	Double airbag 01			Series of amendments not indicated 2 bags	Series of amendments not indicated	NO
UN R95 - Occupant Protection in Lateral Collisions	Rev.1			Series of amendments not indicated	Series of amendments not indicated	NO
UN R 135 Pole side-impact protection	NO			NO	NO	NO
UN R13H – Braking of vehicles of categories M_1 and N_1 (year of version)	R13 Rev.3 00 series Airbag ESC			Series of amendments not indicated	Series of amendments not indicated ABS	ABS only
UN R140 - Electronic Stability Control Systems	R13-H 00 or GTR 9 from 2022			NO	NO	NO
UN R127 – Pedestrian Safety	00 from 2025, new models			NO	NO	NO
UN R32 – Vehicle Behavior in Rear-End Collision	00			NO	NO	NO
UN R25 – Approval of Head Restraints	Rev.4			Series of amendments not indicated and GTR No 7	Series of amendments not indicated	YES NO rear central seats
Vehicle emissions related to the corresponding UN Regulation						
UN R83 –M_1 and N_1 Motor Vehicle Emissions	EURO 5/V			EU and American cycle	NO	NO

Item	Argentina	Brazil	Colombia	Ecuador	Mexico	Uruguay
UN R101 – Carbon Dioxide Emissions and Fuel Consumption	NO			NO	NO	NO
UN R103 – Replacement Pollution Control Devices	NO			NO	NO	NO
Child Safety Restraint (CSR) Systems related to the corresponding UN Regulation						
UN R44 Child Restraint Systems	YES last series of amendments			NO		Series of amendments not indicated + USA + Brazil
UN R129 Enhanced Child Restraint Systems				NO		

CHAPTER I-3. Proposal for vehicle regulations based on the mandatory application of selected UN Regulations

I-3.1 Regulatory Proposal

Below is the proposed vehicle legislation based on the 17 selected UN Regulations. Each country may make the necessary adjustments to adapt these rules to its own legal framework. The legislative proposal in this study has been developed as a regulation.

1. PURPOSE

1.1. The purpose of this regulation is to develop a set of standards applicable to vehicles, their parts and components on the basis of type-approvals issued according to the UN Regulations annexed to the UN Agreement, signed in Geneva on 20 March 1958[10]. In accordance with paragraph 4, only the equivalent FMVSS, CMVSS and EPA standards shall be accepted as alternatives under the conditions set out in the different subparagraphs of paragraph 4 below.

1.2. Importing or registering a vehicle covered by the scope of paragraph 2 below shall not be allowed unless it conforms to a type approved in accordance with the provisions of the UN Regulations annexed to the 1958 Agreement referred to in paragraph 4 below, subject to the exceptions set out in paragraph 10 below.

2. SCOPE

2.1. This regulation covers all models of M_1 and N_1 derived from M_1 vehicles, as well as M_1 vehicles derived from N_1 vehicles.

3. DEFINITIONS

3.1. For the purpose of understanding this regulation, the definitions set out in the UN Regulations referred to in this Regulation and the following definitions shall apply:

Chassis: frame or structure of a motor vehicle that supports all components of the vehicle.

Unibody or self-supporting chassis: A unibody (or self-supporting frame) is a vehicle frame which incorporates the chassis and the occupant and components compartment in one single piece with mounts that support the engine.

Type-approval (of a vehicle with regard to a system or a part thereof): means the approval of a type of vehicle with regard to a system or a part pursuant to a UN Regulation.

International Whole Vehicle Type Approval: whole vehicle type approval according to the provisions of UN Regulation No. 0.

Importer: A natural or legal person who imports vehicles, components or parts of vehicles.

Type-approval marks: The mark to be affixed by the manufacturer of the vehicle, or part thereof, after type-approval of the vehicle, equipment or part has been granted for each unit in accordance

[10] Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions, signed in Geneva on 20 March 1958.

with the provisions of each UN Regulation. Approval marks identify the UN Regulation (most of the time) and the corresponding series of amendments and coincide with the agreed approval code.

Contracting Party to the Agreement (CP): A country which has joined or acceded to the 1958 Agreement.

UN Regulations requirements: The conditions that each vehicle, equipment or part must meet in order to be approved.

UN Regulation ONU: UN Regulation annexed to the 1958 Geneva Agreement.

Amendments to the UN Regulations: The UN Regulations may be amended through: series of amendments, supplements, revisions and corrigenda.

Series of amendments: Substantial modification of a UN Regulation (change of scope or new requirements) requiring a change in the approval mark.

Supplements: Minor modification of a UN Regulation (which does not change the scope). The approval mark does not need to be modified.

Revision: A consolidation of several documents of a UN Regulation. At present, revisions are the same as the series of amendments.

Corrigenda: a modification to correct a mistake.

Technical Service (TS): A laboratory officially designated by the Type Approval Authority (TAA) to carry out the tests specified in each UN Regulation.

Vehicle type, its variants and versions: A category of vehicles which do not differ in the characteristics specified in each UN Regulation. Each different type requires a new type-approval.

Vehicles of category M_1: Vehicles used for the transportation of passengers, comprising no more than eight seats in addition to the driver's.

Vehicles of category N_1: Vehicles used for the transportation of goods and having a maximum mass of no more than of 3.5 tons.

Vehicles of category N_1 derived from M_1: Vehicles used for the transportation of goods with a maximum mass of no more than 3.5 tons with the same general structure and shape as a pre-existing M_1 category vehicle.

4. TECHNICAL REQUIREMENTS OF THE VEHICLE, ITS PARTS AND COMPONENTS

4.1. All vehicles, their parts and their safety and emission components shall conform to an approved type in accordance with the relevant UN Regulation as defined in paragraphs 4.4 and 4.5 below. The approval shall be granted according to the series of amendments referred to in each of the subparagraphs of the above-mentioned paragraphs 4.4 and 4.5.

4.2. In order to verify the validity of the approval and its adherence to regulations, the corresponding type-approval certificate issued and signed by the type-approval authority of one of the Contracting Parties to the 1958 UN Agreement applying the relevant UN Regulation must be submitted. The report of the officially designated technical service which conducted the approval tests and the technical documentation submitted by the manufacturer to the technical service responsible for conducting the approval tests must also be included.

4.3. Verification of compliance of vehicles, their parts, components and equipment with the type approvals indicated in paragraphs 4.4.1 to 4.4.11 and 4.5.1 to 4.5.3 shall be carried out in three stages:

4.3.1 Documentary verification of the type-approval certificate, the technical service test report and the technical documentation listed in paragraph 4.2 above.

4.3.2 Verification of a type unit to verify that it conforms to the documentation submitted.

a) Each time a batch of vehicles covered by the documentation indicated in paragraph 4.2 above is imported, a spot test should be conducted on at least one unit from the group in order to verify that it conforms to the type approval granted as indicated in paragraph 4.2 above.

4.3.3. Conformity control for each of the UN Regulations shall be carried out at least once every two years. The authority responsible for verifying conformity may carry out verification controls at any time. Conformity of Production may be verified by following any of the procedures referred to in paragraphs 4.3.3.1 or 4.3.3.2 below:

a) If the manufacturer or importer provides satisfactory proof that the conformity of production has been established by the approval authority, conformity may be verified by the procedure described in paragraph 4.3 above.

b) If satisfactory proof is not submitted as mentioned in paragraph 4.3.3.1 above, approval tests shall be repeated by the manufacturer or importer to verify conformity. Said approval tests shall be conducted through the technical services officially designated to carry out approval tests as provided for in each relevant UN Regulation.

4.3.4 The Ministry or authority responsible for carrying out each verification stage referred to in paragraphs 4.3.1, 4.3.2 and 4.3.3 of this section shall set the fees which shall cover the relevant costs.

4.4 Vehicle Safety Requirements.

4.4.1. Safety-belt anchorages and ISOFIX anchorages.

a) All motor vehicles must conform to an approved type with regard to safety-belt anchorages under the 04 series of amendments in UN Regulation No. 14 (Uniform provisions concerning the approval of vehicles with regard to safety-belt anchorages, Isofix anchorages systems and Isofix top-tether anchorages and i-Size seating positions) annexed to the 1958 Agreement. Belt anchorages shall be mandatory for three-point belts in all available seating positions where passengers can travel. An exception is made for a period of no more than 12 months from the publication of these regulations for the middle rear seating position, which may have anchorages for a two-point safety-belt provided that no version of that model in the world has three-point belts anchorages.

b) All motor vehicles must have at least two seating positions with Isofix anchorages and its corresponding top-tether or support leg; included in the approval with respect to UN Regulation No. 14. Models which do not have such anchorages available in any version worldwide shall be exempted for a period of no more than 12 months from the publication of this document.

c) Alternatively, Isofix top tethers and lower anchorages may comply with the requirements laid down in UN Regulation No. 145 in its original series (Uniform provisions concerning the approval of vehicles with regard to Isofix anchorages systems, Isofix top tether anchorages and i-Size seating positions).

d) In the event that seat belt anchorages do not comply with the approval standards provided under the above-mentioned UN Regulation No. 14, or said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 210 (Seat Belt Anchorages) or CMVSS 210 respectively must be demonstrated and the manufacturer or the US or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.2 Safety belts

a) All motor vehicles must conform to an approved type with regard to safety belts under the 06 series of amendments to UN Regulation No. 16, uniform provisions concerning the approval of: (i) safety-belts, restraint systems, child restraint systems and Isofix child restraint systems for occupants of power-driven vehicles; (ii) vehicles equipped with safety-belts, safety-belt reminders, restraint systems, child restraint systems and ISOFIX child restraint systems and i-Size child restraint systems, annexed to the 1958 Agreement. Three-point safety-belts are mandatory in all passenger seating positions available. Exceptions shall be made for a period of no more than 12 months from the publication of this regulation for the middle rear seat, which may have a two-point safety-belt provided that no version of that model in the world is equipped with three-point safety-belts.

b) 36 months after these Regulations have been published, only type approvals compliant with the 07 series of amendments to UN Regulation No. 16 shall be accepted.

c) Failure to comply with the approval standards provided under the above-mentioned UN Regulation No. 16, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 208 (Seat Belt) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

d) Failure to comply with the approval standards provided under the above-mentioned UN Regulation No. 16, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 209 (Seat Belt Assemblies) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.3 Seats and their anchorages

a) Vehicle seats must be approved to the 08 series of amendments to UN Regulation No 17 (Uniform provisions concerning the approval of vehicles with regard to seats, their anchorages and head restraints).

b) Failure to comply with the approval standards provided under the above-mentioned UN Regulation No. 17, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 207 (Seating System) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.4 Head restraints

a) All motor vehicle seats must have head restraints in all seating positions where passengers can travel. Head restraints, and their installation in the vehicle must be approved with regard to the 04 series of amendments to UN Regulation No. 25 (Uniform provisions concerning the approval of head restraints whether or not incorporated in vehicle seats) annexed to the 1958 Agreement.

b) Alternatively, head restraints must comply with the provisions of Global Technical Regulation GTR No. 7 on head restraints.

c) Failure to comply with the requirements provided under the above-mentioned UN Regulation No. 25 or GTR No. 7, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 202 (Head Restraints) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.5 Protection in the event of a frontal collision

a) Vehicles must comply with the 02 series of amendments to UN Regulation No. 94 (Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a frontal collision.) annexed to the 1958 Agreement.

b) 36 months after these Regulations have been published, only type approvals compliant with the 03 series of amendments to UN Regulation No. 94 shall be accepted.

c) Failure to comply with the requirements provided under the above-mentioned UN Regulation No. 94, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 208 (Occupant Crash Protection) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.6 Protection in the event of a lateral collision

a) Vehicles must comply with the 03 series ofamendments to UN Regulation No. 95 (Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a lateral collision.) annexed to the 1958 Agreement.

b) Failure to comply with the requirements provided under the above-mentioned UN Regulation No. 95, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 214 (Side Impact Protection) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.7 Pole Side Impact Protection

a) Vehicles must comply with the original version of UN Regulation No. 135 (00 series of amendments) (Uniform provisions concerning the approval of vehicles with regard to their Pole Side Impact performance).

b) 36 months after these Regulations have been published, only type approvals compliant with the 01 series of amendments to UN Regulation No. 135 shall be accepted.

c) Alternatively, vehicles must comply with the provisions of Global Technical Regulation GTR No. 14- POLE SIDE IMPACT.

4.4.8 Protection in the event of a rear-end collision

a) Vehicles must be comply with the original version of UN Regulation No. 32, (00 series of amendments) (Uniform provisions concerning the approval of vehicles with regard to the behavior of the structure of the impacted vehicle in a rear-end collision) annexed to the 1958 Agreement.

b) Failure to comply with the requirements provided under the above-mentioned UN Regulation No. 32, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 224 (Rear Impact Protection) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted.

4.4.9 Pedestrian Safety

a) Vehicles must comply with the 01 series of amendments to UN Regulation No. 127 (Uniform provisions concerning the approval of motor vehicles with regard to their pedestrian safety performance) annexed to the 1958 Agreement.

b) 36 months after these Regulations have been published, only type approvals compliant with the 02 series of amendments to UN Regulation No. 127 shall be accepted.

b) Alternatively, vehicles must comply with the provisions of the latest version of Global Technical Regulation GTR No. 9- Pedestrian Safety.

4.4.10 Breaking

a) Vehicles must comply with the original version of UN Regulation No. 13-H (00 series of amendments) (Uniform provisions concerning the approval of passenger cars with regard to braking) annexed to the 1958 Agreement.

b) 36 months after these Regulations have been published, only type approvals compliant with the 01 series of amendments to UN Regulation No. 13-H shall be accepted.

c) In any of the cases provided for in paragraphs a) and b) above, all vehicles covered by these regulations must be equipped with ABS. The ABS system shall have been tested according to annex 6 of UN Regulation No. 13-H, and its presence shall be included in the type-approval certificate issued by the type-approval authority and in the test report issued by the designated technical service which has conducted the corresponding tests.

d) Failure to comply with the requirements provided under the above-mentioned UN Regulation No. 13-H, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 135 (Light Vehicle Brake Systems) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted. In any case, vehicles shall be equipped with ABS.

4.4.11 Electronic Stability Control

a) Vehicles must be equipped with Electronic Stability Control (ESC). Therefore, they must comply with Supplement 15 of the original version (00 series of amendments) of UN Regulation No.13-H (Uniform provisions concerning the approval of passenger cars with regard to braking where ESC is fitted).

b) Alternatively, vehicles can comply with the original version (00 series of amendments) of UN Regulation No. 140 [Uniform provisions concerning the approval of passenger cars with regard to Electronic Stability Control (ESC) systems] annexed to the 1958 Agreement.

c) 36 months after these Regulations have been published, only type approvals compliant with UN Regulation No. 140 shall be accepted.

d) Alternatively, vehicles equipped with Electronic Stability Control (ESC) systems must comply with the provisions of the latest version of Global Technical Regulation GTR No. 8- Electronic Stability Control systems.

e) Failure to comply with the requirements provided under the above-mentioned UN Regulation, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with FMVSS 126 (Electronic Stability Control Systems) must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance. In addition, a Blue Ribbon certificate for the model in question must be submitted

4.5 Requirements on vehicle emissions.

4.5.1 Emissions of M_1 and N_1 categories of vehicles

a) Vehicles must comply with the 06 series of amendments to UN Regulation No. 83 (Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements) annexed to the 1958 Agreement.

b) 36 months after these Regulations have been published, only type approvals compliant the 07 series of amendments to UN Regulation No. 83 shall be accepted.

c) As an alternative to UN Regulation No. 83, UN GTR No. 15 may be required (Worldwide Harmonized Light vehicles Test Procedure).

d) Failure to comply with the requirements provided under the above-mentioned UN Regulation No.83, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with Code of Federal Regulations 40 CFR 86 for the Standard Setting Part and 40 CRF 1066 for Tests Procedures must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance.

e) Note: Compliance with this technical regulation is subject to the quality of the fuels available on the local market. In the event that the quality of the fuel available is not adequate, the emissions requirement may be reduced accordingly.

4.5.2 CO_2 emissions and fuel consumption

a) Vehicles must comply with the original version (01 series of amendments) of UN Regulation No. 101 (Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range, and of categories M_1 and N_1 vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range) annexed to the 1958 Agreement.

b) 36 months after these Regulations have been published, only type approvals compliant the 01 series of amendments to UN Regulation No. 101 shall be accepted.

c) Failure to comply with the requirements provided under the above-mentioned UN Regulation No.101, or in the event that said compliance is not sufficiently documented, and provided that the vehicle is manufactured in the USA or Canada, compliance with Code of Federal Regulations 40 CFR 600 for the Standard Setting Part must be demonstrated and the manufacturer or the USA or Canadian government must provide the necessary financial resources for the government to conduct independent verification tests and market surveillance.

4.5.3 Replacement anti-pollution devices

a) Replacement pollution control devices for vehicles must comply with the original version (00 series of amendments) of UN Regulation No. 103 (Uniform provisions concerning the approval of replacement catalytic converters for power-driven vehicles) annexed to the 1958 Agreement.

5. CONFORMITY ASSESSMENT AND TESTING

5.1. Test methods for assessing the conformity of the safety and emission components referred to in this Regulation shall be solely those set out in each of the normative documents referred to in this Regulation, i.e. the corresponding UN Regulations annexed to the 1958 Geneva Agreement.

5.2. In certain cases, assessments of FMVSS standards shall be conducted by independent laboratories appointed by the government or competent authorities with funding provided by stakeholders or a government.

5.3. In certain cases, assessments of EPA standards shall be conducted by independent laboratories appointed by the government or competent authorities with funding provided by stakeholders or a government.

6. REFERENCE DOCUMENTS

UN R13H	Braking of vehicles of categories M_1 and N_1.
UN R14	Safety-belt anchorages
UN R145	ISOFIX anchorages
UN R16	Safety belts
UN R17	Anchorages, strength of seats, and head restraints
UN R94	Protection of occupants in the event of a frontal collision
UN R95	Protection of occupants in the event of a lateral collision
UN R 135	Pole Side Impact Protection
UN R140	Electronic Stability Control
UN R127	Pedestrian Safety
UN R32	Vehicle Behavior in Rear-End Collisions
UN R25	Approval of head restraints

UN R83	Emissions of M_1 and N_1 categories of vehicles
UN R101	CO_2 Emissions and Fuel Consumption
UN R103	Replacement pollution control devices
UN R44	Child Restraint Systems
UN R 129	Enhanced Child Restraint Systems
UN GTR 7	Head Restraints
UN GTR 14	Pole Side Impact
UN GTR 9	Pedestrian Safety
UN GTR 8	Electronic Stability Control Systems
UN GTR 15	Worldwide Harmonized Light vehicles Test Procedure

7. AUTHORITIES RESPONSIBLE FOR TYPE-APPROVAL AND CONFORMITY OF PRODUCTION ASSESSMENTS

7.1. The authorities responsible for granting type-approval pursuant to UN Regulations annexed to the 1958 Agreement are the approval authorities of the Contracting Parties to the 1958 Agreement applying that UN Regulation, after appropriate tests have been carried out by a technical service designated by the Approval Authority.

7.2. The Approval Authority referred to in paragraph 1 above shall ensure the conformity of production in accordance with the provisions laid down in each UN Regulation and in the 1958 Agreement.

8. SUPERVISORY AND CONTROL AUTHORITY

[Note: Each country shall list in this section the bodies or authorities responsible for monitoring compliance with the provisions of these regulations and for carrying out checks concerning the validity of type conformity certificates corresponding to each regulation, as well as the physical inspection of the units (vehicles)]

9. PENALTIES

[Each country shall determine the penalties for not complying with the provisions of these regulations]

10. REVIEW AND UPDATE

10.1. In order to keep the provisions of these technical regulations up to date, their content shall be subject to a process of revision within a period of no less than 5 years, counting from the date of issue of this regulation. Notwithstanding the previous statements, the incorporation of more safety elements or additional requirements, without modifying modification of existing standards, pursuing the protection of health, life and the environment may be carried out at any time.

11. GENERAL PROVISIONS

FIRST: The regulatory documents referred to in these regulations shall be mandatory. However, if a type-approval is submitted with respect to a series of amendments subsequent to those referred to in Article 4 of these regulations, this type-approval shall be accepted.

SECOND: Vehicles of the diplomatic corps authorized in the country and imported by their owners for the period of their presence in the country, household goods due to change of residence of their owners, vehicles considered as classics, imported vehicles for persons with disabilities and emergency vehicles are excluded from compliance with the approval requirements of paragraph 4. The competent ministry will be responsible for dictating the conditions applied to these exceptions and the requirements to be demanded to these vehicles.

THIRD: These regulations shall become effective 180 days after their publication in the Official Registry.

12. SOLE DEROGATION PROVISION

All provisions of equal or lesser rank that are contrary to the provisions of these regulations, and in particular the Technical Regulations, are hereby derogated [indicate the number of the regulations affected].

13. SOLE TRANSITORY PROVISION

It must be communicated and published in [indicate the official publishing medium].

I-3.2 Observations regarding the proposed regulations

The regulation requires approval regarding the corresponding UN regulations. This implies that the vehicle, system, part or component of the vehicle has received a certificate of type-approval or approval signed by one of the contracting parties to the 1958 UN WP.29 agreement and this applies or covers units intended specifically for this country.

This procedure provides a guarantee to the administrations of countries accepting the agreed approvals. Under the current procedures in place in the six countries studied, this guarantee is not available.

These regulations suggest that the UN Global Technical Regulations (GTRs), developed within the legal framework of the 1998 Agreement, be accepted as an alternative to the UN Regulations annexed to the 1958 Agreement. It should be noted that the World Forum WP.29 is in charge of maintaining the technical requirements of both UN Regulations and UN GTRs at the same level of requirement. The difference between both types of regulations is that UN Regulations have administrative provisions and UN GTRs do not. Therefore, it is easier to control the UN Regulations thanks to the type-approval procedure and the accompanying documentation (approval certificate, test report by an official technical service, technical documentation submitted by the manufacturer, conformity of production) all controlled by the administration of the country granting the approval. Due to the ease of this control over the type-approval, almost all contracting parties to the two agreements (1958 and 1998) apply the GTRs by requiring that the vehicle, system or part is approved in accordance with the corresponding UN Regulations.

The regulations accept that for vehicles that provide no justification regarding their approval or that the approval cannot be sufficiently documented, compliance with the American FMVSS standard or the corresponding "Code of Federal Regulation (CFR)" of the EPA is accepted as long as the vehicle has been produced in the USA or Canada or the device is intended for vehicles produced in the USA or Canada. The equivalent CFR to UN Regulation No. 103 (Uniform Provisions concerning the Approval of Replacement Pollution Control Devices for Power-driven Vehicles) is not included since it does not exist.

In these cases, and so that the country that accepts the compliance with the American standards can make production compliance easier, the "Blue Ribbon" and the economic means (on the part of the manufacturer or the government of the USA or Canada) will have to be provided. In this way, the national government will be able to achieve conformity of production tests in independent laboratories, which implies the accomplishment of the tests required in the respective standard.

For those countries which have more requirements than those in the UN Regulations in question, these requirements must be maintained, but it is advised that they gradually be replaced with the corresponding UN Regulation.

A second paragraph should be added to Article 10, stating that the addition of new requirements or the updating of existing ones with stricter ones will be accomplished by a equal or inferior rank provision and only by the ministry or body responsible for approval. This is intended to speed up the adoption of the requirements for national approval of vehicle types (models). It should be noted that UN Regulations are updated with new amendments and supplements that must be incorporated into national regulations so that they do not become obsolete.

The first general provision provides that if a type-approval certificate is submitted for a series subsequent to that required, it must be accepted, since the new series of amendments is always more demanding than the previous one. This resolves the hypothetical case that the evolution of the Regulations by the World Forum WP.29 is faster than the advances in these regulations.

By means of the derogation provision, all provisions of equal or inferior rank that are contrary to the provisions of the regulations are annulled. It will be necessary to consider the rank with which these regulations must be approved in each country, in order to ensure that the regulations currently in force and which are to be replaced by these regulations are of equal or lower rank.

CHAPTER I-4. Control system for type-approvals based on UN regulations

This chapter proposes a simple system for type-approval control based on UN regulations, covering the analysis of the approval documentation, the physical inspection of the vehicle to be approved, and the production control on which the regulation presented in chapter I-3 above is based.

I-4.1 Analysis of the approval documentation

The manufacturer or importer shall submit the approval documentation with regard to the relevant UN Regulation, to the national authority responsible for issuing the relevant authorization (national type-approval system) including:

1. The approval certificate issued by the Type-approval Authority (TAA) of a contracting party to the 1958 Agreement of the UN WP.29 duly signed and meeting the UN Regulation in question,
2. The test report of the technical service designated by the TAA of a contracting party to the 1958 agreement of UN WP.29 to conduct approval tests, duly stamped and signed, and
3. The technical documentation submitted by the manufacturer to the technical service of the TAA of a contracting party to the 1958 Agreement of the UN WP.29 in charge of performing the tests. This technical documentation shall be sealed by the technical service which carried out the tests.

These three documents, which actually constitute the complete approval file for each UN Regulation, make it possible to identify clearly that a given vehicle has been approved correctly in accordance with the relevant UN Regulation.

The technical documentation to be submitted by the manufacturer is specified in each and every one of the UN Regulations annexed to the 1958 Agreement.

The model of the approval certificate is also defined in each and every one of the UN Regulations annexed to the 1958 Agreement.

In case of doubts regarding the authenticity of the above-mentioned documents, the TAA of a contracting party to the 1958 Agreement of the UN WP.29 can always be asked about the authenticity of the documents and the protective order of the units for each country specifically.

I-4.2 Physical inspection of vehicles

Physical inspection is a key element in the approval process. It involves verifying that the type (model) of vehicle for which approval is requested corresponds to what is described in the documentation presented in the previous section.

Despite the importance of this verification, it is not carried out in any of the six countries included in this study. All LAC countries examined only conduct a document verification.

This physical inspection of the vehicle is not intended to repeat the approval tests, but rather to verify that the vehicle representative of the type (model) is the one defined in the documentation submitted.

With the type-approval certificate, the test report and the manufacturer's documentation required in the proposed regulation, a fair amount of verified information is available, which allows a simple way to corroborate that the vehicle is the one defined in the documentation.

The simplest and most obvious way is to check the approval mark, which must be engraved on the component, and match this to the mark on the approval certificate. For systems, such as the braking system, the approval mark must be placed on a label on the vehicle, as specified in each UN Regulation.

Independent of the approval marks, which must match the approval code, both the component and the system can be identified from the amount of technical information in the documents submitted.

For example, the model of the approval certificate and the approval marks of UN Regulation No. 13-H are reproduced in Annex I-5 of Part I. As can be seen, the information contained is considerable, which facilitates a visual inspection of the vehicle to check that it is as described in the documentation.

Annex I-6 to Part I of the Annexes to this section reproduces for each and every one of the proposed UN Regulations the requirements for the marking of vehicles and their parts and examples of approval marks.

Physical verification of the vehicle and the preparation of the corresponding report for all the UN Regulations suggested in this study is estimated to take between three and four days. Undoubtedly, once the necessary experience in this process has been gained, the time allocated to the physical verification of vehicles could be reduced.

Physical verification should be carried out in the following steps (see **Table 4**):

- (Column 1 of the table). A review of the vehicle type-approval documentation to be submitted by the importer or manufacturer. This documentation must contain:
  - Approval certificate with its approval number and mark.
  - Report from the technical service (lab) designated by the approval authority. This certificate, whose model is indicated in each of the UN Regulations, must contain all the data indicated there. The technical service report must be duly sealed.
  - Technical documentation submitted by the applicant of the approval to the technical service for the tests to be performed. The technical documentation must be duly sealed by the technical service.
- (Column 2 of the table). Notification of acceptance or refusal of the documentation. Whether or not there are any anomalies, the person concerned shall be informed accordingly.
- (Column 3 of the table). Physical verification of the vehicle to ensure that the vehicle representative of the type is supported by the documentation submitted. The vehicle will be physically checked to make sure it corresponds to what is described in the documentation. The components or systems of the vehicle (brakes, bumpers, etc.) must have an approval mark, which must coincide with that of the documentation. Each of the parts (safety belts, etc.) must have the approval mark engraved and coincide with that of the approval certificate. Annex I-6 of Part I of this study reproduces both the marking requirements and examples of UN Regulations markings recommended in this study.
- (Column 4 of the table). Notification of corrections or acceptance after the inspection of paragraph 3.
- (Column 5 of the table). Verification report providing a notification of the decision, which includes either the acceptance of the vehicle type or its rejection.

It should be noted that the approval tests do not need to be rerun for this approval verification.

In addition, a Conformity of Production (COP) must be provided periodically (ideally every 2 years). The COP is carried out by the contracting party signing the approval. In addition to this COP of the authority that granted the approval, it should be repeated locally by the local technical authority with a periodical verification of the same model already approved or approved by type. Notwithstanding the previous statements, and in the case of imported vehicles, it is suggested to perform a physical inspection, to verify that the vehicle is covered by the approval granted, each time there is a new batch of vehicles. In addition, the administration may conduct a COP at any time. This conformity of production would take the same time as that provided for in paragraphs 3, 4 and 5 if only one inspection is made upon reception. If it is intended to carry out a COP by performing all the tests, the designated Technical Services must be available, which, for the time being, is not part of this stage.

Table 4. Estimate of physical inspection times

Times	1. Verification of the documentation	2. Notification of the acceptance or refusal of the documentation	3. Physical verification of the vehicle vs documentation	4. Notification of corrections or acceptance	5. Verification report providing a notification of the decision	TOTAL
Hours per UN Regulation	1	1	1 or 2	1	1	5 - 6
Hours for the 15 UN Regulations applied to vehicles	15	3 (1)	8 (2)	3	3	26 – 32 (3)
Hours per Child Restraint System (UNR 44 or UNR 129)	1	1	1 (4)	1	1	5

Notes:

(1) The notification of acceptance or refusal of the documentation will be made once for all regulations rather than for each regulation individually.
(2) When conducting checks on the vehicle, some may be done simultaneously to save time.
(3) The total time varies depending on whether or not defects are found in the documentation and visual inspection of the vehicle.
(4) In this case, it refers to the time for checking the child restraint system.

If there are errors in the documentation and/or visual inspection of each vehicle (steps 1 and 3), they must be communicated to the interested party and, once corrected, the corresponding steps 1 to 5 must be repeated.

In the above calculation, it is assumed that both the vehicle and the documentation are available to the administration at the premises to be established or through the digital platform developed for that purpose in Chapter I-5 of this section. If the public worker has to travel to any premises, the time and cost required for that transfer must be accounted for.

Time estimates vary depending on how well the documentation is prepared by the manufacturer or importer. In the beginning, and if a manufacturer is inexperienced, it is easy to find errors between the partial approvals and the type description with its variants and versions. Perhaps a week per vehicle (5 working days per type) is an accurate estimate forthe beginning of the process).

For those countries that currently apply other UN Regulations not listed in **Table 1**, , the time needed to verify those UN Regulations, in addition to the 17 on the list, should be extended.

Once all the actors involved (importers, manufacturers and administration) have gained experience, the times can be reduced to two/three working days, provided that the documentation is well prepared. If the documentation submitted needs to be corrected, the time needed for the importer or manufacturer to make changes will expand. This additional time is not an additional cost for the administration.

To finance the man-hours that the administration must employ in this process, a fee (to be paid by the manufacturer or importer) must be implemented for the verification of the approval that covers the cost of the public worker's time and of the necessary facilities, plus resources to extend the verification networks and equipment where appropriate.

I-4.3 Control of the production of vehicles on the market

Once it is determined the type (model) of vehicle matches the one described in the documentation for each and every one of the required UN Regulations, to the administration should ensure that the vehicles placed on the market under the protection of the type (model) that has been approved in the country coincide with those verified according to the procedure in the previous section.

Conformity of production can be achieved via two procedures:

- By requiring documentation issued by the TAA of a contracting party to the 1958 agreement of UN WP.29 which granted the approval at that time. In this case, a physical inspection of the vehicle would be carried out as described in section I-4.2.
- Carrying out the approval tests in a laboratory of the administration or in an independent lab designated by the administration for this purpose.

Regardless of requiring the conformity issued by the TAA of the contracting party to the 1958 Agreement of the UN WP.29 which granted the approval (paragraph a of the previous section), the national authority can - and should - require tests to be carried out in authorized laboratories designated for the performance of the tests provided for in each UN Regulation.

If the holder of the approval fails to carry out the COP, the approval may be withdrawn.

Conformity of production shall be checked every two years or more often, unless another, shorter period is stipulated in the relevant UN Regulation.

The approval authority may check the premises of the holder of the approval (manufacturer, assembler or importer), at any time and require that the COP be carried out.

CHAPTER I-5. Digital support platform

I-5.1 Introduction

Document management for type approvals is often challenging because of the high volume of information that needs to be handled and managed. The validity and veracity of such documentation is critical. Considering that each country has few experts in this area dedicated to type approvals (sometimes less than ten professionals per country) and that eventually the volume of approvals depends more on the variety of models available than on the size of the market, this process tends to become a bottleneck in the admission of new models to markets. In some cases, the model is accepted even without documentary verification, due to the aforementioned lack of relevant expertise.

The governments of the region have faced difficulty in this area and these difficulties limit the capacity to control what is imported or produced in the country. It is imperative to develop a robust approval team to deal with the implementation and control of new technical regulations in LAC markets.

The average approval process per model compliant with regulatory package recommended in this study requires at least 300 sheets of paper per model in each folder. Any process with this level of data will face challenges managing said documents, as well as monitoring their validity and storage.

Today there are affordable digital tools that can make this process easier, more efficient and provide experts with the materials they need.

The RPG, through the work carried out by Latin NCAP, proposes the development of a digital tool that will allow this work to be done, while helping carry out the approval process in a streamlined manner, safeguarding the privacy of inspectors by avoiding direct interaction with the interested party, with the aim of carrying out objective and independent verification.

I-5.2 The need for the platform

The platform was created as an option by the Latin NCAP team in view of the limited human resources available to the regional administrations, as well as the limited technical knowledge required to manage the approval process. In the vast majority of cases, highly qualified professionals that are fully committed to their work are available. However, they lack resources and while they have excellent knowledge in some areas, it is not sufficient to cover all relevant areas required by a wide range of vehicle type approvals.

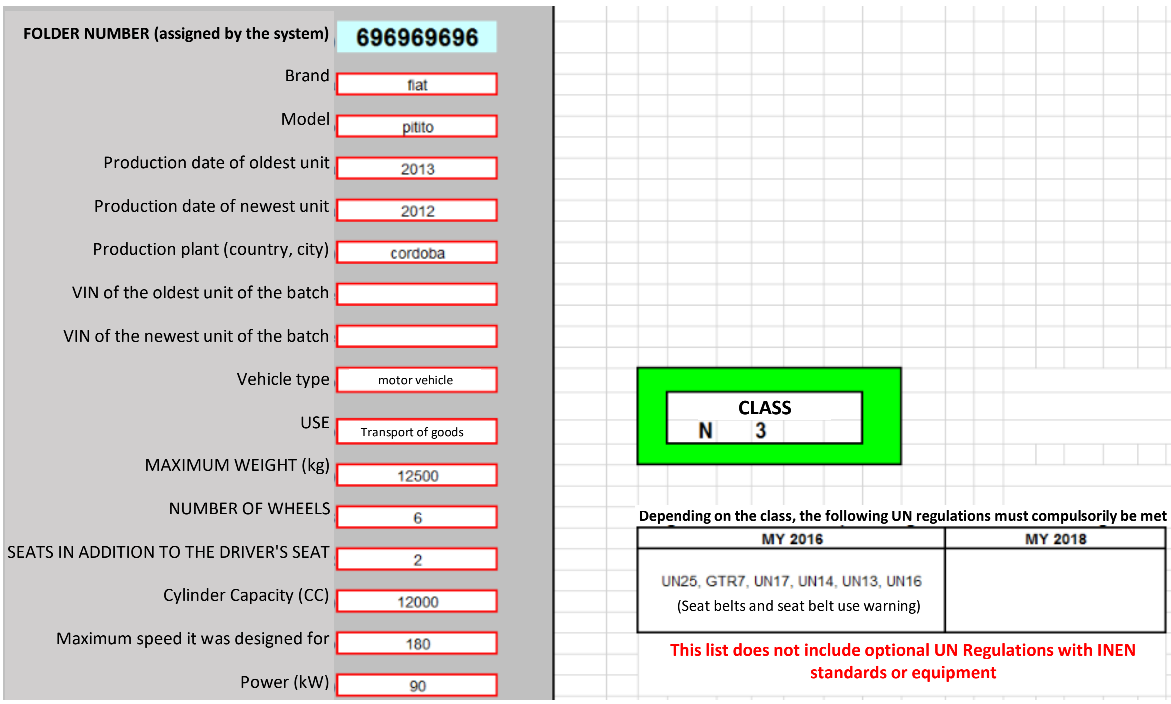
I-5.3 The functionality of the platform

The digital platform will offer the possibility of managing the approval of a given model (or vehicle type, using the terminology of the 1958 Agreement and its annexed Regulations) in an interactive way with the interested party, where interested parties can digitally upload their documents and follow the evaluation process of their application. On the other hand, the body responsible for the approval process may monitor the interested party's documentation load, evaluate said documentation, issue approval decisions and, more importantly, have all the supporting documents and approval certificates submitted in digital format with the aim of using them as evidence and learning material. The digital platform will be able to offer an interactive guide for the remote inspection of units to be approved until the accuracy of the documentation submitted can be verified. This tool aims to support the approval process, but it does not replace the functions of those who must decide whether to grant an approval.

I-5.4 Structure of the platform

The platform has 4 types of "clients": an interested party (who represents the manufacturer or brand interested in having a model approved); an "approval inspector" (the technician responsible for the approval of a given model); an "administrator/supervisor" (the person responsible for managing and supervising the approval processes); and, finally, a "consultant" (responsible for confirming the validity of the documents).

The platform has an entry form for "clients" that serves as the front page of a new type-approval folder. On said cover, the required data must be entered in order to start a new approval folder. The front page resembles the image below:



FOLDER NUMBER (assigned by the system)	696969696
Brand	fiat
Model	pitito
Production date of oldest unit	2013
Production date of newest unit	2012
Production plant (country, city)	cordoba
VIN of the oldest unit of the batch	
VIN of the newest unit of the batch	
Vehicle type	motor vehicle
USE	Transport of goods
MAXIMUM WEIGHT (kg)	12500
NUMBER OF WHEELS	6
SEATS IN ADDITION TO THE DRIVER'S SEAT	2
Cylinder Capacity (CC)	12000
Maximum speed it was designed for	180
Power (kW)	90

CLASS
N 3

Depending on the class, the following UN regulations must compulsorily be met

MY 2016	MY 2018
UN25, GTR7, UN17, UN14, UN13, UN16 (Seat belts and seat belt use warning)	

This list does not include optional UN Regulations with INEN standards or equipment

Figure 3. Entry form that serves as front cover for clients applying for a new approval

A folder number is issued when the request to open a new approval folder is made at a single window. At that time, clients may be charged a fee to cover the costs arising from generating said folder number. The folder number will ask clients to set a secure password using a mobile phone. Together with the folder number, a new approval is opened by loading the data indicated above.

This first step confirms the type of vehicle (M_1 and N_1 derived from M_1) and the document uploading process starts.

There can be several "approval inspectors" (HOM1, HOM2, ...), as well as several "clients" (C1, C2, ...), a single "ADMIN" administrator and several "consultants" (CON1, CON2, ...).

Each "approval inspector" can deal with more than one "client" at a time. They can also monitor each process under their supervision.

Each "client" can have more than one approval in progress at the same time.

Each "consultant" can receive more than one query at the same time from different "folders".

The "Administrator" can control and monitor all the processes.

I-5.5 How the platform works

A "client" opens a new folder where he/she enters all the data requested in accordance with the "cover" folder form.

The "client" is granted immediate access to a panel that guides him through the process of loading digital documents such as photographs of the model to be approved, approval documents, whether it is the first approval, location of the batch of units to be verified and the date when the units will be available for approval inspection, and the highest and lowest VIN number of the batch to be approved. The guided process will ask clients questions and request that they upload documentation step by step. The process can be paused at any time by saving the information. Data can be uploaded from anywhere in the world at any time, as long as the folder code and password are entered.

The platform will assign the folder to an "approval inspector" randomly, but it will distribute the workload equally among all "approval inspectors".

Each "approval inspector" shall have a panel with all the approval folders in process and they will be able to choose which one they want to open and access the information. When accessing the information, a list of the standards or regulations required shall appear. In green or enabled, they will see those regulations for which the "client" has uploaded all the necessary documentation. The approval process for which the approval inspector is responsible will only be enabled (according to preferences) when all the documentation requested by the platform has been loaded into the system. Approval inspectors may open each "regulation" and access the documents loaded there by clients, but they cannot edit or delete them. When reading the documentation, the system will consult the "approval inspector" about the contracting party that issued the document. The "approval inspector" must respond by entering the corresponding number (sub-index of letter E of the certificate).

For each approval document where the "approval inspector" enters the country code of the contracting party issuing the certificate, the platform sends an e-mail to the technical authority of that country with a simple query about the veracity of the document in question. In response, the contracting party is expected to click "YES” or “NO" on the platform itself. Once all the documents (one for each technical regulation) have been answered with a "YES" by the contracting party issuing said documents, the platform enables the physical verification of the vehicles by the "approval inspector".

The platform enables the "approval inspector" to carry out a physical inspection of the vehicles via mobile device. The platform will ask for the approval inspector’s access key with a mobile verification code. The platform shall then ask the inspector to switch on the mobile phone GPS and to take a photograph of the lot and another photograph of the model to be approved. One by one, the platform will ask for photos of each marking for each regulation which take the form of a visible mark or presence of equipment. The platform will ask for photos of each of them. After 3 attempts the administrator must be asked permission online to undo the step at that point. Once the photos have been uploaded, the platform asks the "approval inspector" to confirm that the markings and equipment have been checked and requests final confirmation. The verification requires components (e.g. brake systems) to be checked, as well as to check some key equipment that shall be detailed in each case on the platform to guide the approval officer.

When final confirmation is given by the "approval officer", the folder is marked as approved and the platform sends the client an e-mail with the details of the approval, as well as a notification to the relevant entity (Customs, Ministry, etc.) stating that model XXX with VIN batch from XXX to XXX has been approved and authorized.

When the same model is re-entered into the market in another lot, regulations or anything required in the event of changes must be updated, as well as the corresponding documentation. If there are no changes, the mobile physical inspection of the vehicle is directly enabled and admission of the vehicle is granted.

Within a period of no more than 2 years, the platform shall ask "approval inspectors" to request verification of some random certification of a random model.

CHAPTER I-6. Regulatory Accelerators: NCAP programs

I-6.1 Introduction

Historically, in countries with mature economies, manufacturers have come to meet higher requirements than those proposed by governments in the past. Such markets have been able to accelerate the process by focusing on the voluntary rapid change of brands by using tax incentives and by providing independent and impartial vehicle safety information to consumers so that they can make an informed purchase. Consumer information programs are known as NCAP (New Car Assessment Program). There are currently nine programs worldwide, all of them supported by governments in each region, both politically and financially. At the moment, the only exception is the Latin NCAP which only has external funding.

The NCAP programs propose a safety assessment for cars based on the UN Regulations detailed above, but with some broader requirements, e.g. the speed for the frontal impact test is carried out at 8km/h more and for the side impact test, the assessment of child restraint systems is carried out inside the vehicle, which is not required or analyzed by UN Regulations.

The UN's own document: Decade of Action for Road Safety 2011 - 2020 under the "safe vehicles" pillar identifies as a priority the adoption of technical standards such as those recommended herein by the UN and, secondly, the implementation of NCAP programs, apart from five other recommendations.

NCAP programs complement each country's regulatory system and they are not intended to act as a substitute. NCAP programs rate the physical integrity offered by a vehicle above the acceptance level of UN Regulations, giving a 5-star rating to those models which achieve the greatest physical integrity for occupants in impact tests.

In countries with mature economies such as the United States, Australia and the European Union, the vast majority of the models in the rolling fleet over are models which have been given a 4- or 5-star rating by the local NCAP program. Thanks to the fact that most models offer higher safety levels than those required by local governments, many lives have been saved even when their safety levels are not mandatory under government requirements. For instance, in Europe ESC was standard equipment on most models at least 10 years before it became mandatory, and something similar happened with head protecting side airbags, which did not become mandatory until 2019. The reason why brands are choosing to make this equipment standard before law requires such a high standard lies in the brands' desire to achieve a 4- or 5-star rating in local NCAPs. Low ratings may negatively influence public opinion and sales or may cause a negative reaction from shareholders.

In markets like Australia, the government has required models used in the government fleet to have at least 4 or 5 safety stars. This measure was adopted by private fleets globally, generating a positive impact on the market towards greater voluntary safety standards implementedby manufacturers.

The Latin American and Caribbean New Car Assessment Program (Latin NCAP) has been working since 2010 to promote greater vehicle safety by providing independent safety ratings of car models sold throughout the Latin American and Caribbean (LAC) region.

Latin NCAP is a non-profit civil-society organization registered in Uruguay, made up of automobile clubs, consumer associations, insurance-related organizations and road safety NGOs. Since June 2017 it also accepts national and state governments of different regions as members. It is supported by international organizations such as Bloomberg Philanthropies, FIA Foundation, the Global New Car Assessment

Program (Global NCAP), the Inter-American Development Bank (IDB) and the International Consumer Research & Testing (ICRT) organization.

New vehicle assessment programs (NCAP) have proven effective tools for improving vehicle safety. The first NCAP program was launched by the National Highway Safety Administration (NHTSA) in the United States in 1979. There are currently nine active NCAP programs or similar organizations around the world. NCAP is a market-based mechanism that provides consumers with independent information on vehicle safety performance. These organizations often assess cars with a slightly higher safety standard than required by local legislation. They also serve to supplement the minimum requirements of the legislation and to encourage vehicle manufacturers to offer products that exceed legal standards.

The low levels of injury and death in markets with mature economies such as Europe, USA, Japan and Australia, can be explained by the models circulating there, which are mostly rated with four and stars. Four- and five-star models have higher levels of protection than those required by the basic UN regulations. If vehicles in these regions only barely met the UN protection requirements, the results would be worse.

The regulations proposed at UN level by WP29 are the backbone of all these developments and advances. Without such regulations, even mature economies might not have achieved such impressive safety standards.

I-6.2 UN mandate for the promotion of safer vehicles

In 2011, the United Nations launched a Decade of Action for Road Safety supported by a Global Plan which, among other things, recommends that new vehicle assessment programs be implemented in all regions of the world to improve the availability of information on the safety performance of motor vehicles for consumers. This proposal was endorsed by the United Nations General Assembly in its resolution 66/260, enacted in April 2012, which urged United Nations Member States to "encourage the implementation of new vehicle assessment programs in all regions of the world to improve the availability of information to consumers on the safety performance of motor vehicles".

This Global Plan also encourages governments to implement the most important vehicle safety standards (UN Regulations annexed to the 1958 UN Agreement) developed by the UN World Forum for the Harmonization of Vehicle Regulations (WP.29). In 2015, the mid-term review of the UN Decade was carried out at the 2nd Global High-Level Conference on Road Safety, hosted by the Government of Brazil, and the Brasilia Declaration was adopted. The Declaration calls on UN member states to "promote the adoption of policies and measures to implement United Nations vehicle safety regulations or equivalent national standards to ensure that all new motor vehicles meet applicable minimum regulations for occupant and other road users protection, with seat belts, airbags and active safety systems such as anti-lock braking systems (ABS) and electronic stability control (ESC) fitted as standard". The Brasilia Declaration was also endorsed by another UN General Assembly resolution (70/260), adopted in April 2016.

In 2015, the UN also adopted a new framework of Sustainable Development Goals (SDG) whose Health Target no. 3 includes the goal of halving the number of global deaths and injuries from road traffic crashes by 2020. Together, the UN Global Plan for the Decade, the General Assembly resolutions and the SDGs represent the strongest commitment to improving road and vehicle safety. In addition, Target 17 of the SDGs focuses on partnerships, strongly encouraging multi-sectoral cooperation between government and civil society organizations.

I-6.3 Vehicle safety in the LAC region

Since the launch of the UN Decade, some governments in the Latin American and Caribbean region have made progress in implementing the UN minimum vehicle safety requirements or equivalent regulations. Argentina, Brazil, Ecuador, Mexico and Uruguay are beginning to implement UN minimum impact test requirements. However, this progress is too slow and not in line with the requirements of the Brasilia Declaration and the United Nations General Assembly resolutions on road safety. Unfortunately, as revealed in the Global Status Report on Road Safety 2015 published by the World Health Organization (WHO), most LAC countries do not yet apply any of the main UN standards on vehicle safety.

Latin NCAP expects that by 2020 all governments in the LAC region will have adopted the main vehicle safety regulations as set out in Global NCAP's proposed roadmap for Safer Cars 2020. Similar recommendations have also been included in a new SaveLives Policy Package released in May 2017 by the WHO in support of the Health and Sustainable Development Goals, with regard to road safety. Latin NCAP believes it is imperative that the LAC region act on these recommendations prior to the comparative benchmarking of country performance that will be undertaken at the end of the UN Decade of Action.

The benefits of ensuring a more widespread compliance with minimum crash test standards have been demonstrated by a recent study published by Global NCAP on potential road safety gains from implementing vehicle safety improvements. The report, carried out by the UK's Transport Research Laboratory (TRL), estimates that up to 40,000 car occupant fatalities and 400,000 serious injuries could be avoided between 2016 and 2030 if the UN's car safety regulations were appliedin just four LAC countries (Argentina, Brazil, Chile and Mexico). The economic assessment conducted as part of the study suggests that these reductions could save up to US$143 million by 2030.

In order to show a comparison between UN and Latin NCAP standards based on injury criteria, a particular injury scale AIS3 (*Abbreviated Injury Scale* level 3)can be compared. Chest injuries, such as occurrence of multiple rib fractures with pneumothorax, hemothorax, and minor cardiac contusion. While the UN Regulations state that a 30% or less of occurrence of AIS3 chest injuries is acceptable, Latin NCAP indicates that the protection is full or "good" (no residual injuries, in line with a 5-star rating) when the probability of occurrence of this type of injury is 5% or less. UN ratings indicate the "minimum acceptable" threshold, i.e. the baseline, and Latin NCAP gives a 5-star rating only to those who achieve a very low risk of occurrence of that injury.

Latin NCAP believes that Latin Americans do not have to pay more for the basic security offered as standard in markets with mature economies. Latin NCAP's goal is to democratize vehicle safety.

I-6.4 The catalytic role of Latin NCAP

The work carried out by Latin NCAP has proved a catalyst for action by LAC governments and car manufacturers. Between 2010 and 2016 Latin NCAP assessed over 75 models. During this period, most car manufacturers made consistent progress towards offering vehicles for sale that had earned a four- or five-star rating on more models. These rating levels far exceed the applicable regulatory requirements in the LAC region, when such requirements exist. For example, as of 2016 it is required that vehicles have a crash prevention system, i.e. Electronic Stability Control (ESC), in order to obtain a four- or five-star rating in Latin NCAP. To date, no LAC government has imposed the use of ESC, although Argentina and Brazil are committed to doing so in the near future.

Unfortunately, Latin NCAP's test results also show that some of the best-selling models on the market have a zero- or one-star safety rating. This poor performance among the most popular exposes those consumers to a higher risk of life-threatening injuries in case of a frontal collision at only 40 miles (65 km) per hour or in case of a lateral collision at only 30 miles (50 km) per hour.

The growing number of four- and five-star vehicle models shows how Latin NCAP's independent rating and safety assessments are acting as a catalyst to improve vehicle safety in the LAC region. Manufacturers are increasing the safety specification of their products, actively promoting their five-star results and helping create a market for safer vehicles. However, much remains to be done to ensure that Latin NCAP can continue to build on its initial success and work towards eliminating zero- and one-star car production, and further contribute to preventing more deaths and injuries on the roads of the LAC region.

Latin NCAP has estimated the proportion of the total sales volume of the 20 best-selling models between 2010 and 2015 that have been rated in the main automotive markets in LAC: Argentina, Brazil and Mexico. Putting the three markets together, at least 58.8% of the total sales volume between 2010 and 2015 was evaluated by Latin NCAP.

Table 5. Proportion of sales volume of the 20 best-selling models from 2010 to 2015, rated in the main automotive markets in LAC: Argentina, Brazil and Mexico.

Country	2010	2011	2012	2013	2014	2015
Argentina	41.16%	49.22%	49.26%	46.21%	49.48%	52.82%
Brazil	48.44%	52.76%	50.64%	58.28%	60.43%	67.63%
Mexico	33.42%	33.28%	40.16%	39.68%	38.72%	38.77%
Total	**44.90%**	**50.25%**	**48.53%**	**52.73%**	**54.21%**	**58.80%**

This is a relevant time period, particularly given that only USD 2.5 million has been invested to develop Latin NCAP's rating activities in that period, including 2016. However, it is an important priority for Latin NCAP to achieve greater model assessment coverage to meet consumer expectations and to continue to encourage manufacturers to build safer cars.

Of the region's 50 best-selling models, Latin NCAP has assessed 43, and of the 20 best-selling models, 19 were evaluated by Latin NCAP.

I-6.5 Latin NCAP findings

Latin NCAP has shown that airbags alone are not enough. Airbags are useful, but if the car's structure collapses, the occupants will sustain serious injuries regardless of the performance of the airbags. For this reason, Latin NCAP has demonstrated that governments should require the adoption of UN Regulations, such as Regulation No. 94 (Protection of the occupants in the event of a frontal collision), in which the structure is tested along with other systems, such as airbags and safety belts, to confirm that all these safety elements work together to protect the occupants.

Latin NCAP has also shown that there are cars that look the same as those in other markets, but do not perform as well in crash tests, not only because of the equipment, but also because of the structures, which are built with less reinforcement, poor welding quality and poor interior material quality.

Latin NCAP has made it clear that, even though this region has some well-designed vehicles in the simulation software, that is to say vehicles that have been well-conceived from a technical point of view, there are some serious production control problems in the region due to the lack of application of regulations. The negative consequences of the lack of production control have surprised the safety engineers and car designers themselves. When vehicles enter into production in Latin America, they are produced under very poor and deficient controls, resulting in very low safety levels.

I-6.6 Labeling for safer vehicles

The key information tool in NCAP programs is the test data used to calculate the star rating. Latin NCAP stars include both adult and child protection ratings. Star ratings are calculated based on the levels of injury registered by crash test dummies. The results are displayed in stars, and for greater accuracy, images showing colored areas of the body of the adult dummies in the front seats are presented.

In case critical regions of the body, such as the chest, head and neck are colored red, this means that the occupant has a high probability of receiving life-threatening injuries, and consequently this leads to a zero- or one-star result. The areas of the body colored in green indicate that they are intact or have almost full protection after the crash.

The results of the tests are disseminated through the Latin NCAP website (www.latinncap.com), in the free mobile application, social networks and on the labels used, in some cases, by the vehicle manufacturers.

Ford Stand Ford - San Pablo Motor Show 2014

Toyota advertisement -2014

VW Stand - San Pablo Motor Show 2014

Jeep Renegade Advertisement - 2015

Toyota Hilux Advertisement - 2015

VW Golf Advertisement - 2015

VolksWagen Up! Advertisement -2015

Toyota Corolla Advertisement – 2017

VW Polo Poster – 2017

VW Polo Sticker – 2017

Figure 3. Examples of advertisements for different car models

The use of Latin NCAP labels is voluntary and Latin NCAP does not have funds like other NCAPs to assess all market models. Furthermore, no government in the region requires all market models to be assessed in order to inform consumers. Therefore, the use of labels is limited to manufacturers who perform well at Latin NCAP and have an obvious incentive to promote their good safety performance.

It is understood from the NCAP experience that if the few popular models that have been assessed have improved voluntarily and substantially as a result of low performance, it is reasonable to expect that if all market models were assessed a lot more zero star models would exit the market without any government intervention. That is why all NCAPs around the world are supported by local governments as they catalyze their markets towards safer vehicles without political cost. Unfortunately, in Latin America, Latin NCAP does not yet have such involvement and support from regional governments.

There is strong precedent for mandatory NCAP labeling. In the USA, for example, since 2006 it has been mandatory for new vehicles to display local NCAP information. This is linked to the Monroney sticker (named after Oklahoma Senator Mike Monroney, who introduced a U.S. labeling standard in 1958) that shows the car's price and must be affixed to the side window of vehicles, and now also includes fuel economy and safety information. The NCAP labeling requirements were updated in 2011 to include an overall score from the NHTSA's star-rating system.

If Latin NCAP labels were to become mandatory in major LAC markets, this would massively expand the provision of vehicle safety information to consumers and substantially increase the number of vehicles tested throughout the region.

Latin NCAP's ability to carry out independent testing depends on the generosity of its major supporters and contributors. However, to achieve long-term sustainability of vehicle safety improvements throughout the LAC region, a more permanent system needs to be developed. A mandatory labeling scheme would help achieve this.

The labeling system would simply require a zero- to five-star rating to be displayed. There would be no minimum star requirement to allow a vehicle to be sold in the market. Thus, the proposed measure simply relates to consumer information and would not contain requirements that could, for example, raise issues relating to the application of World Trade Organization rules on technical barriers to trade.

The mandatory labeling system proposed by Latin NCAP would also help deter some manufacturers that have been found to be using false or misleading safety star ratings, thus creating unfair competition among manufacturers.

Latin NCAP has exposed a number of cases where car manufacturers have used star rating labels from other NCAP programs in the world, which are not valid for the model being sold in the LAC region. If Latin NCAP labels become the standard source of information for the region's market, this will deter any tendency by manufacturers or their dealers to misinform consumers about the true safety ratings of the vehicles being sold.

In addition to increasing the number of cars that can be rated, such a system would also help strengthen the safety testing capacity of vehicles in the LAC region. Currently, there is a lack of independent laboratory capacity for testing vehicles, whether for consumer NCAP ratings, type approval or conformity of production testing. There is also a lack of trained engineers in the region to carry out this essential work. A mandatory labeling system would increase the demand for both laboratory facilities and greater vehicle safety engineering capacity. This would fuel investment in building that capacity to support the growing automotive industry in the LAC region.

I-6.7 Latin NCAP's proposed "Stars in Cars" cooperation and partnership

To address these concerns, Latin NCAP is putting forward a new proposal for cooperation and partnership "Stars in Cars", consistent with the Sustainable Development Goals (SDGs) for health and a partnership with governments in the LAC region. The cooperation and partnership proposal will include the following components.

A government (national, state or regional) that joins the proposed cooperation and partnership:

1. Shall require the assessment of new vehicles and the display of Latin NCAP star ratings on labels on new vehicles as a mandatory requirement on all passenger-car models sold in the market, or those who wish to have a local license or registration plate. The star rating shall not become a constraint for putting a model on the market or to obtain a license or registration plate. The implementation proposed is divided in two stages, for example: the first 6 months, the 30 best-selling models should be rated, then, 12 months later, all models that have sold more than 150 units per year and have a market price equal or lower than USD 40,000 should be rated. In addition, tax incentives could be offered to models that use the star rating system for a period of up to 6 months, and while the label or safety rating would be optional, it could later become mandatory. It is recommended that official notification be made directly by the government to the parent company.
2. Shall automatically receive the right to sit and serve on the Latin NCAP Board of Directors for governments;
3. Shall nominate engineers from their own government to be trained in vehicle safety assessment and regulation systems by participating in Latin NCAP's safety rating activities at little or no costs to governments and professionals;

4. Shall produce a "rescue sheet" for each model being assessed, and may eventually designate rescue services to be trained in extraction modes for the vehicles assessed at little or no cost to governments. The rescue sheets shall indicate the rescue mode and critical points of the vehicle when extricating people after a crash.

I-6.8 Case studies

Between January 2017 and July 2018, thanks to publications made by Latin NCAP, at least 500,000 new cars per year included, among other things, basic side impact protection as standard equipment in accordance with UN Regulation No. 95 (protection of the occupants in the event of a lateral collision). If Latin NCAP had not chosen these popular models (among the best-selling in the region) to be assessed, it would never have known that they did not comply with UN Regulation 95, and consequently these vehicles would not have improved.

1. Chevrolet Onix

The Onix is the best-selling model in Brazil. Including its sedan (Prisma) version, it has sold up to 400,000 units per year. If its Spin (MPV) version is also included, the sales volume is even greater. The model was assessed in 2014 by Latin NCAP only taking into account frontal collision protection and it achieved four stars for adult protection. In 2017, Latin NCAP assessed that model again, this time taking into account lateral collision protection and it achieved zero stars for adult protection. Under the conditions of the lateral crash test, this vehicle would also fail UN Regulation No. 95. However, this model was legally sold throughout Latin America without meeting this side impact protection requirement which has been mandatory in Europe since 1997. At least 1,200,000 units of this model have been sold since it was launched on the market in both versions, without taking into account the Spin version, without basic side impact protection in accordance with UN Regulation No. 95.

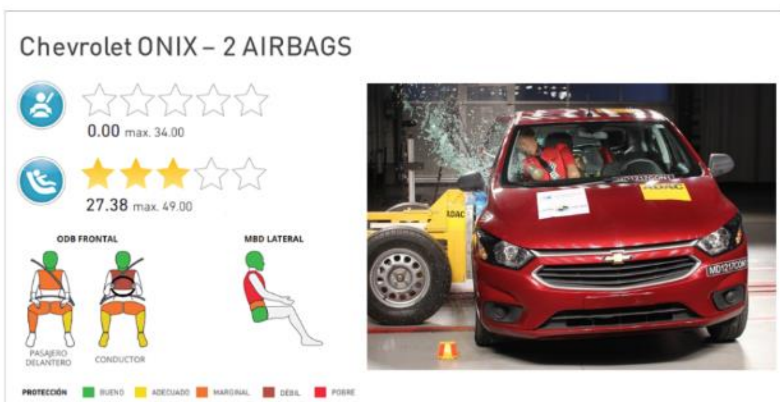


Figure 4. Chevrolet Onix test result

Following said result, the brand reacted favorably by improving the model's side impact protection from January 2018 onwards. Latin NCAP re-assessed the model and awarded it a three-star rating for adult protection.

Figure 5. Chevrolet Onix/Prisma test result

Even without the improved side impact protection, it would have remained legal to sell this model in LAC markets. It is understood that the improvements made in this model is a consequence of the pressure exerted by the publication of the results by Latin NCAP. Had it not been assessed and the results published, this model would certainly not have been improved. It is a voluntary improvement implemented before legal requirement and surpassing the minimum requirements.

2. Chevrolet Aveo (Mexico)

The Aveo was the best-selling model in Mexico, with a sales volume of over 40,000 units per year. It was assessed in 2015 by Latin NCAP and it was awarded zero stars in adult protection. In 2011, it sold more than 480,000 units in Mexico alone. This model has been sold in at least four other markets in the region, including Uruguay, Chile, Ecuador and Colombia. This model did not incorporate airbags as standard equipment.

Following the zero-star result, in 2017 the brand added two standard airbags. Latin NCAP assessed this model again with the new frontal and side impact protocol, and it was awarded zero stars again, despite the addition of airbags.

Figure 6. Chevrolet Aveo test result

In December 2017, Chevrolet announced they would cease production of this model and they would start production of a new model called New Aveo in Mexico and Sail in other markets in the region, which would substitute the old model. This new version has not yet been assessed by Latin NCAP. Had the test result not been published, it is understood that the brand might not have made the decision to withdraw this model from the market.

3. Ford Ka/Figo

This model was the third best-selling model in Brazil. In 2015, its frontal collision protection was rated four stars. In 2017, as with the Chevrolet Onix and other models, this model was assessed again, this time, for lateral collision protection, and it was awarded zero stars in adult protection. Under the conditions of the lateral crash test, this vehicle would also fail the UN basic standard test on the protection of vehicle occupants in the event of a lateral collision (UN Regulation No. 95). However, this model was legally sold throughout Latin America without meeting this side impact protection requirement which has been mandatory in Europe since 1997.

Since it was launched on the market, at least 350,000 units of this model have been sold in both versions (sedan and hatchback), without the basic side protection specified in UN Regulation No. 95. The zero-star rating is valid for the Ka model, as well as for the Figo (Mexico) model which looks the same.

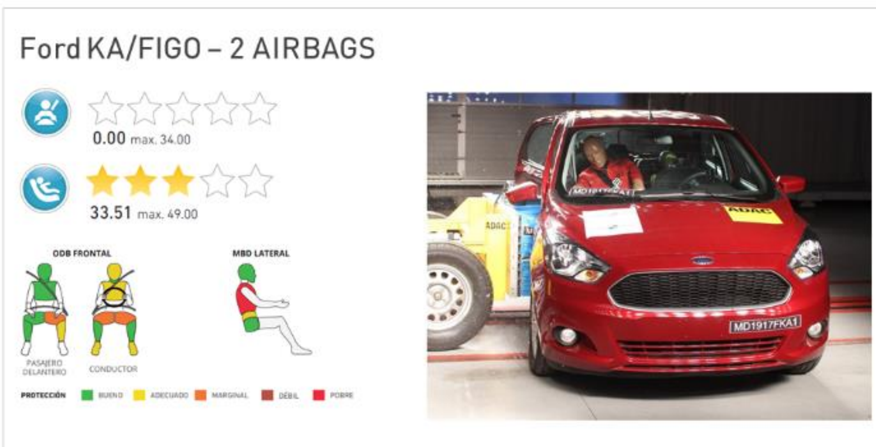


Figure 7. Ford Ka/FIGO test result

Following said result, the brand reacted favorably by improving the model's side impact protection from June 2018 onwards. Latin NCAP re-assessed the model and awarded it a three-star rating for adult protection.

Figure 8. Ford Ka test result

Even without the improved side impact protection, it would have remained legal to sell this model in LAC markets. It is understood that the improvements made in this model were a consequence of the pressure exerted by the publication of the results by Latin NCAP. Had it not been assessed and the results published, this model would certainly not have been improved. This was a voluntary improvement implemented before it was required by local law and it surpassed the minimum requirements. This improvement applies only to the Ka model, not to the Figo model (Mexico).

However, in comparison with the European Ford Ka (identical to the LAC model), there are still dramatic differences despite the improvements carried out by the brand. In identical crash test scenarios, the behavior of the structure of the European model was better, showing less deformation (penetration of side impact bars) and the European model has standard side torso airbags and head protecting side curtain airbags.

European Ford Ka (2017)

Improved Brazilian Ford Ka (2018)

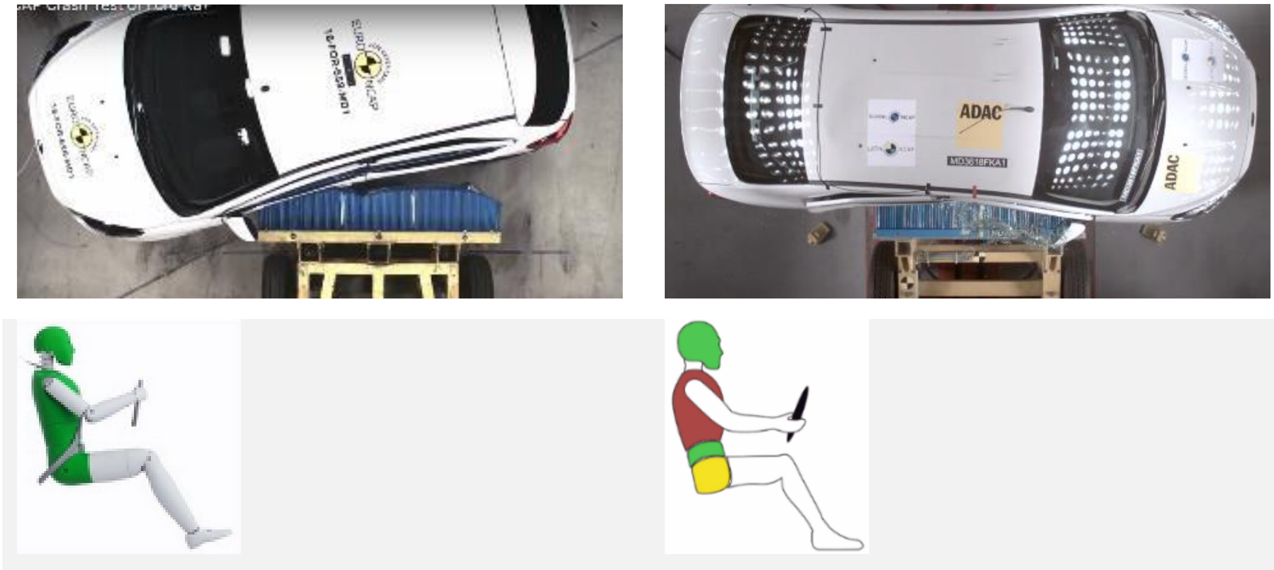


Figure 9. Comparison of crash test results on the European Ford Ka (2017) and Brazilian Ford Ka (2018)

4. Renault Kwid

Renault's Kwid model was developed for emerging economies. It was launched in 2016 for the first time in India and was assessed by Global NCAP, being awarded zero stars for adult protection.

Figure 10. Renault Kwid I test result, India 2016

Renault acted very quickly and, a few months later, the evident poor structural performance was improved. However, as the maximum safety measure available (optional) was an airbag, this model was not able to obtain more than zero stars.

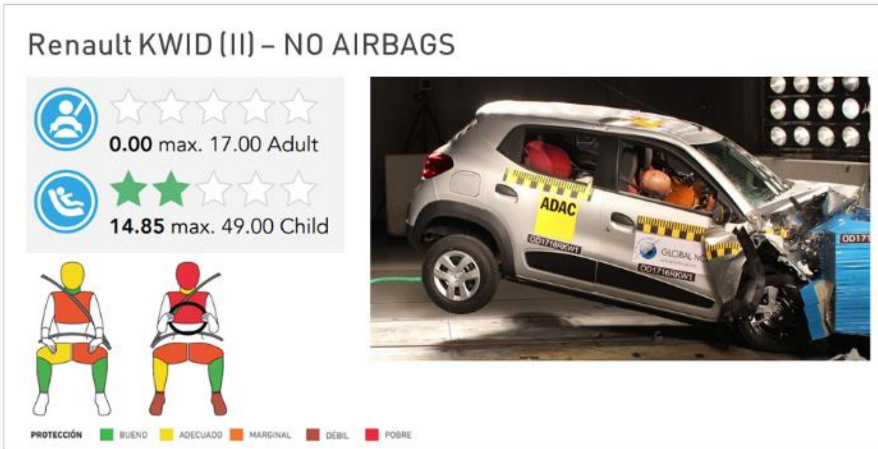


Figure 11. Renault Kwid II test result, India 2016

Renault made an even greater effort and they improved the model after a few months, and with the maximum safety measure (an airbag), the model barely managed to reach a one-star rating for adult protection.

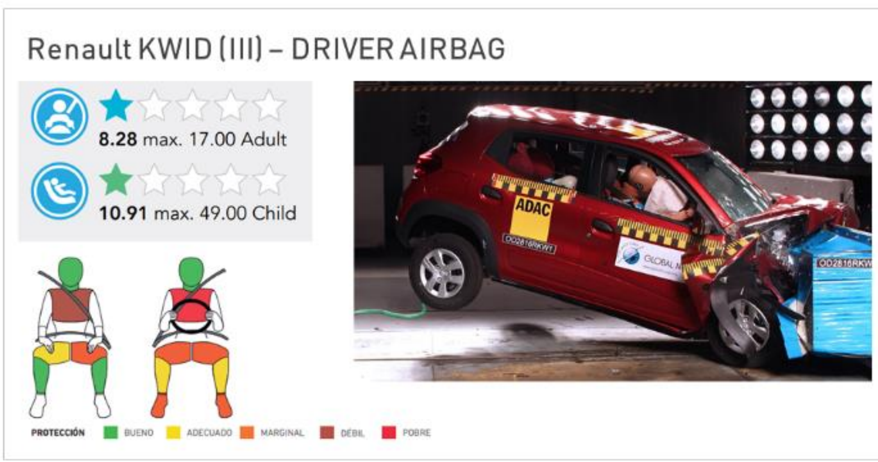


Figure 12. Renault Kwid III test result, India 2016

In 2016, Renault began production of the Kwid for the Brazilian market. However, the performance test results of the Kwid in India, even after the improvements, were poor, so Renault decided to delay the production of the Kwid for Brazil in order to improve its safety performance. In 2007, the Kwid manufactured in Brazil was launched with four airbags as standard equipment, being the cheapest new vehicle in the market and obtaining a satisfactory three-star safety performance rating for adult and child protection in Latin America. The Kwid maintained a sales level of at least 10,000 units per month since its launch.

Figure 13. Renault Kwid test result, Brazil 2017

If Global NCAP had not assessed the Kwid, the Brazilian version would probably not have obtained a three-star safety performance rating for adult and child occupant protection. While this is not a dramatic result, as Latin NCAP's aim is that cars obtain a five-star rating, the improvements developed as a result of the publication of the NCAP results are still beneficial. The Kwid's safety performance exceeds local regulations and is the result of a voluntary decision made by the manufacturer.

5. Renault Sandero

The Sandero is a popular model in the region, sold also as Stepway, Logan and in some markets as Symbol (Chile). It comes from three plants in the region: Brazil, Argentina and Colombia. At least 640,000 units have been sold since its launch.

Latin NCAP assessed this model after its predecessor had got a one-star rating for adult occupant protection in 2012, and the result in 2018 was also one-star for adult occupant protection.

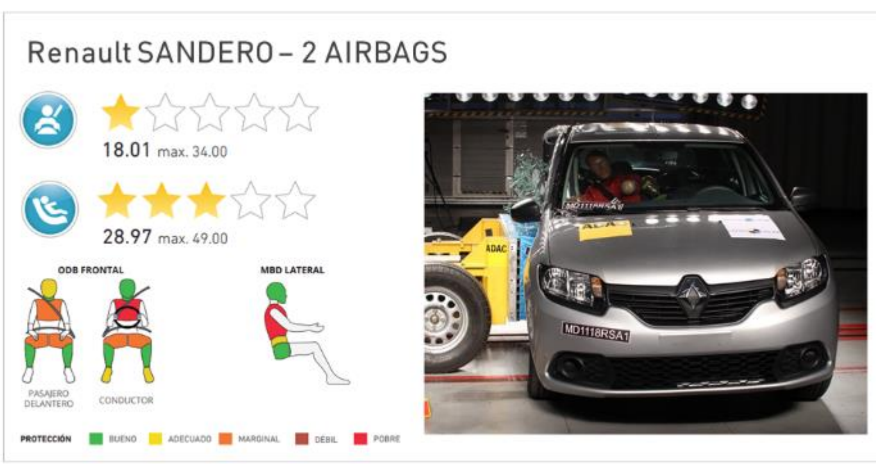


Figure 14. Renault Sandero test result

This model offers side impact protection. The European model, sold as Dacia, offers side airbags covering the body and head in all versions as standard equipment, in addition to the frontal airbags and ESC. In Latin America, this model only offers two frontal airbags and ABS brakes as standard equipment.

As a result of this rating, the manufacturer confirmed that this model would be upgraded between late 2018 and early 2019 and will be tested again to assess progress.

6. Toyota Corolla

The Corolla is the best-selling model in its segment in the region. Since its most recent upgrade, it has sold at least 100,000 units per year in the region. In 2017, this model included side curtain airbags and side-impact airbags, as well as ESC, as standard equipment, in addition to the three frontal airbags it already incorporated as standard equipment previously. With this basic configuration, the Corolla was awarded five stars for adult and child protection. It was also proven that the Corolla had pedestrian protection as standard, thus earning the "*Advanced Award*".

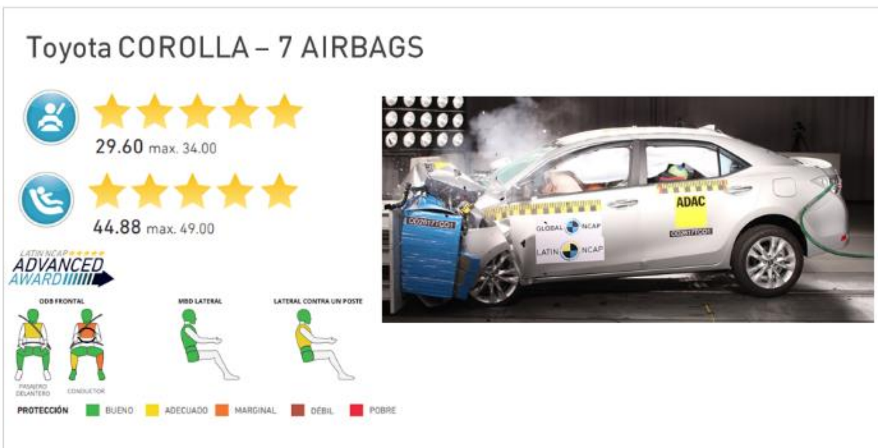


Figure 15. Toyota Corolla test result

Being the best-selling model in its segment, the decision to take it to a maximum rating is the result of a voluntary decision made by the manufacturer in order to become market leaders in this regard. It was not necessary for the manufacturer to show this result since its leadership in sales was already confirmed; however, the brand decided to launch a strong media campaign in Brazil beyond its star rating. The marketing actions included a central page in the newspaper Folha de São Paulo explaining not only the safety performance of this model, but also the importance of safety equipment with reference to the Latin NCAP program. From a budgetary point of view, it would have been impossible for Latin NCAP to even approach such a publication, in form and magnitude.


INFORME PUBLICITÁRIO

FOLHA DE S.PAULO

Corolla é avaliado como o sedã mais seguro da América Latina

O CARRO

Segurança para os pedestres

Toyota do Brasil

Figure 16. Image from Folha de São Paulo newspaper with information about the Toyota Corolla

7.

VW New Polo / Virtus

The VW Polo was launched in 2017 and the Virtus sedan version was launched in 2018. Both models were awarded five stars for adult and child occupant protection. These models belong to the segment known as B+, which is very competitive and popular in the region. VW's decision to manufacture this new five-star model was based on marketing and consumer preferences, but also on the political decision of the manufacturer to offer maximum safety. This model set the standard for this segment and is likely to be followed by others.

Figure 17. Volkswagen Polo test result

These are some of the case studies and success stories from 2017 and 2018. Many other models in the past were further improved, and earlier than required by regulations, thanks to the Latin NCAP crash tests, such as the Nissan Tiida, Fiat Palio, Kia New Rio and Hyundai Accent models, and some other models were withdrawn from production, such as the Nissan Tsuru.

The results or improvements in popular models (Onyx, Ka, Kwid) that affect more than 500,000 consumers per year are the result of carrying out crash tests with market vehicles. If Latin NCAP had not tested these vehicles, they probably would not have been upgraded. Latin NCAP's limited budget explains why some models have not yet been tested. It is estimated that there would be a massive positive impact if all vehicles on the market were tested. The speed and type of improvements promoted by Latin NCAP confirm the potential for a consumer crash-test program in the region, and demonstrate the need for a more comprehensive and sustainable program in the future.

I-6.9 Conclusions

The "Stars in Cars" cooperation and partnership proposal is designed to encourage LAC governments to respond to the United Nations General Assembly's call to "participate in new car assessment programs to promote the availability of consumer information on the safety performance of motor vehicles". It will also help LAC governments meet their obligations under the SDGs on improving road and vehicle safety.

A mandatory Latin NCAP star labeling system will help create a safety market that offers consumers wider choices and promotes a level-playing field among manufacturers. This initiative will also help promote the sustainability of an improved system of vehicle safety regulations by building capacity and technical expertise.

In general terms, for this project it is strongly recommended to use incentives as a tool to generate changes voluntarily by using both the star rating system and the government regulations indicated in this document. The process should play out in the following order: first, presenting the regulatory package; second, asking how long it would take for imported vehicles and manufacturers to comply with the regulations; third, adjusting that amount of time and; finally, offering a tax incentive to those who comply with the proposed regulatory package starting from the day of the enactment of the requirement until the time indicated by the interested parties. Said tax incentive, or any other incentive offered, must be such that a car model including a certain technology costs the same with or without it to thanks to the tax compensation. It is recommended that the social, health and economic benefits be demonstrated in comparison with the value of the tax incentive. It is recommended that the tax incentive be applied per technology and regulation and that the manufacturer and importer be required to ensure that just as the government offers tax incentives, the manufacturer and/or the importer does not make a profit on those incentivized technologies.

It is also strongly recommended that the same mechanism of fiscal and/or tax incentives be applied, as explained above, to non-mandatory technologies such as AEB (Autonomous Emergency Braking) in any of its versions and with immediate effect.

PART II.

THE EFFECT OF VEHICLE SAFETY IMPROVEMENTS ON PUBLIC HEALTH IN THE LATIN AMERICAN AND CARIBBEAN REGION

Presentation of Part II

This second part of the study focuses on analyzing the potential impacts on health, based on the estimate of the number of lives that would be saved and the disability burden averted, as a result of the adoption of safety regulations, as well as other second order effects of safety improvements.

The positive impact of the adoption of the different potential technologies to be implemented in new vehicles is analyzed individually and also as a whole. This is necessary because some safety technologies amplify each others impact, resulting in an even greater safety gain.

The potential savings in productivity and public health demonstrated in this section of the study serve as an input to the economic model developed in the third section of the study, where the potential impacts on the regional economy are estimated.

CHAPTER II-1. Road Safety: a Public Health Problem

II-1.1 Rationale and objective

Road traffic crash injuries are one of the main causes of death and disability in Latin American and the Caribbean (LAC) region especially among young adults [1-3]. Road traffic crashes caused approximately 110,000 deaths in the LAC region in 2016[11]. In addition to deaths, road traffic crashes cause long-term disability and adverse health outcomes. **Table 6** illustrates that road traffic injuries are the fifth leading cause of health loss in the region. In fact, injuries sustained in car crashes are one of the top 10 causes of health loss in most countries in the region and the leading cause of health loss in Ecuador.

Table *7* shows that, among the 15-49 age group, road traffic injuries were the second leading cause of death in the LAC region after domestic violence. Road traffic injuries are among the top two causes of death for this age group in most countries and the leading cause in some countries.

While countries in the region have made notable progress in reducing the burden of communicable diseases and are making substantial progress in preventing some non-communicable diseases, they have not been successful in reducing road traffic injuries. **Table 8** shows that between 2000 and 2016, health loss due to acute respiratory infections in the LAC region decreased by 45%, diarrheal diseases by 64%, and HIV/AIDS by 39%, leading to a much lower ranking for these causes in 2016. Similar success can be seen in the decrease of neonatal mortality, with a 54% decrease in health loss associated with premature birth and a 50% decrease in neonatal encephalopathy, resulting in both causes ranking lower in 2016 than in 2000. However, road traffic injuries remained the fifth leading cause of health loss in the region during this period. In fact, the rate of road traffic fatalities in the region remained fairly stable during this period (**Figure 18**).

Unlike countries in the Latin American and Caribbean region, countries with mature economies have managed to significantly improve road safety. During the first half of the 20th century, countries in Western Europe and North America witnessed a steady increase in road traffic injuries. However, as illustrated in **Figure 18**, during the 1960s, most countries in Western Europe and North America succeeded in reversing this trend, and have since had more than five decades of decreasing fatalities and injuries from traffic crashes. These countries' achievement contrasts sharply with that of countries in the LAC region, where very little progress has been made in reducing road traffic fatalities. Currently, the road traffic death rate in many Western European countries is less than 5 per 100,000 inhabitants, which is less than a quarter of the rate for the Latin American and Caribbean region (**Figure 18**).

Table 6. Main causes of health loss in some selected countries and in the entire Latin American and the Caribbean region in 2016

[11] Overall health loss is measured using Disability-Adjusted Life Years (DALYs), which are the sum of the burden of mortality (years of life lost due to illness or injury) and morbidity (years lost due to non-fatal disability) of the population.

Main causes of health loss in 2016

LAC Region
1. Ischaemic heart disease
2. Interpersonal violence
3. Diabetes
4. Lower back and neck pain
5. Road traffic accident injuries
6. Sense organ diseases
7. Cerebrovascular accident
8. Skin diseases
9. Lower respiratory infections
10. Congenital anomalies

Argentina	Brazil	Colombia
1. Ischaemic heart disease	1. Ischaemic heart disease	1. Interpersonal violence
2. Lower back and neck pain	2. Interpersonal violence	2. Ischaemic heart disease
3. Lower respiratory infections	3. Lower back and neck pain	3. Lower back and neck pain
4. Cerebrovascular accident	4. Road traffic accident injuries	4. Sense organ diseases
5. Skin diseases	5. Cerebrovascular accident	5. Skin diseases
6. Sense organ diseases	6. Sense organ diseases	6. Road traffic accident injuries
7. Road traffic accident injuries	7. Skin diseases	7. Migraine
8. Diabetes	8. Diabetes	8. Diabetes
9. Migraine	9. Lower respiratory infections	9. Congenital anomalies
10. Other musculoskeletal diseases	10. Migraine	10. Cerebrovascular accident

Ecuador	Mexico	Uruguay
1. Road traffic accident injuries	1. Diabetes	1. Ischaemic heart disease
2. Lower back and neck pain	2. Ischaemic heart disease	2. Lower back and neck pain
3. Ischaemic heart disease	3. Chronal renal disease	3. Cerebrovascular accident
4. Lower respiratory infections	4. Interpersonal violence	4. Sense organ diseases
5. Sense organ diseases	5. Road traffic accident injuries	5. Lung cancer
6. Preterm birth	6. Lower back and neck pain	6. Skin diseases
7. Skin diseases	7. Sense organ diseases	7. Road traffic accident injuries
8. Diabetes	8. Congenital anomalies	8. COPD
9. Congenital anomalies	9. Skin diseases	9. Self-inflicted injuries
10. Interpersonal violence	10. Migraine	10. Migraine

Source: GBD, *Global Burden of Disease*-2016

Note: Health loss is measured in Disability-Adjusted Life Years (DALYs), a summary measure of the population's health status that combines the health burden of mortality and disease. In the table, orange denotes communicable, neonatal, nutritional, and maternal diseases, blue indicates non-communicable diseases, and green shows injuries.

Table 7. Main causes of death among young and middle-aged adults, aged 15-49, in selected countries and in the Latin American and Caribbean region as a whole in 2016

Main causes of death, People between 15-49 in 2016

Argentina	Brazil	Colombia
1. Road traffic accident injuries	1. Interpersonal violence	1. Interpersonal violence
2. Self-inflicted injuries	2. Road traffic accident injuries	2. Road traffic accident injuries
3. Ischaemic heart disease	3. Ischaemic heart disease	3. Self-inflicted injuries
4. Interpersonal violence	4. HIV/AIDS	4. HIV/AIDS
5. Cerebrovascular accident	5. Cerebrovascular accident	5. Ischaemic heart disease
6. Lower respiratory infections	6. Self-inflicted injuries	6. Cerebrovascular accident
7. HIV/AIDS	7. Lower respiratory infections	7. Lower respiratory infections
8. Breast cancer	8. Cirrhosis - hepatitis C	8. Breast cancer
9. Cervical cancer	9. Alcohol use disorders	9. Other neoplasias
10. Other neoplasias	10. Drownings	10. Leukemia

LAC Region
1. Interpersonal violence
2. Road traffic accident injuries
3. Ischaemic heart disease
4. HIV/AIDS
5. Self-inflicted injuries
6. Cardiovascular accident
7. Chronic renal disease
8. Lower respiratory infections
9. Diabetes
10. Cirrhosis - hepatitis C

Ecuador	Mexico	Uruguay
1. Road traffic accident injuries	1. Interpersonal violence	1. Self-inflicted injuries
2. Interpersonal violence	2. Road traffic accident injuries	2. Road traffic accident injuries
3. Self-inflicted injuries	3. Chronal renal disease	3. Interpersonal violence
4. HIV/AIDS	4. Ischaemic heart disease	4. HIV/AIDS
5. Natural disasters	5. Self-inflicted injuries	5. Ischaemic heart disease
6. Ischaemic heart disease	6. Diabetes	6. Cerebrovascular accident
7. Cerebrovascular accident	7. Cirrhosis - hepatitis C	7. Breast cancer
8. Chronic renal disease	8. HIV/AIDS	8. Lung cancer
9. Lower respiratory infections	9. Alcoholic liver disease	9. Mechanical failures
10. Diabetes	10. Cerebrovascular accident	10. Drownings

Source: GBD-2016.

Note: In this table, orange indicates communicable, neonatal, nutritional, and maternal diseases, blue indicates non-communicable diseases, and green shows injuries.

Table 8. Changes in the ranking of health loss causes (DALYs) between 2000 and 2016 in LAC

Latin America and the Caribbean
Both sexes. All ages. DALYs

2000 Rank	2016 Rank
1. Ischemic heart disease	1. Ischemic heart disease
2. Lower respiratory infections	2. Interpersonal violence
3. Interpersonal violence	3. Diabetes
4. Preterm birth	4. Lower back and neck pain
5. Road traffic crash injuries	5. Road traffic crash injuries
6. Congenital anomalies	6. Sense organ diseases
7. Cerebrovascular accidents	7. Cerebrovascular accidents
8. Diarrheal diseases	8. Skin diseases
9. Lower back and neck pain	9. Lower respiratory infections
10. Diabetes	10. Congenital anomalies
11. Skin injuries	11. Chronic renal disease
12. Sense organ diseases	12. Migraine
13. Migraine	13. Preterm birth

14. HIV/AIDS	14. Depressive disorders
15. Depressive disorders	15. Other musculoskeletal diseases
16. Neonatal encephalopathy	16. Anxiety disorders
17. Chronic renal disease	17. COPD
18. COPD	18. Alzheimer
19. Neonatal sepsis	19. Falls
20. Anxiety disorders	20. HIV/AIDS

Source: GBD-20162.

Note: In this table, orange indicates communicable, neonatal, nutritional, and maternal diseases, blue indicates non-communicable diseases, and green shows injuries.

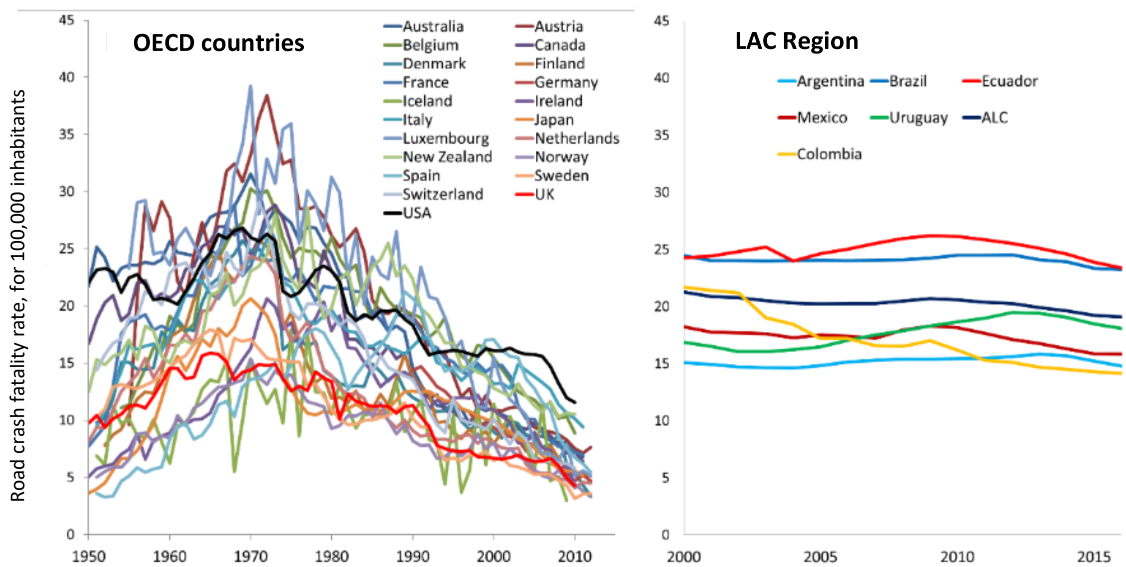


Figure 18. Trends in road crash fatalities in OECD countries and the Latin American and Caribbean regions

Source: The results for the OECD countries are based on the authors' calculations, using data from the national death registry; data for the LAC region is drawn from GDB-2016.

The success of countries with mature economies in reducing road traffic injuries was driven by a paradigm shift in thinking about road safety in the 1960s. Before this, road safety was primarily seen as a problem of poor driver behavior and therefore most solutions focused on changing such behavior through education or law enforcement. These approaches were largely ineffective and, as a result, road traffic injuries continued to increase (**Figure 18**).

However, during the 1960s, a more balanced approach to road safety was developed. It included interventions focused on: vehicles, road infrastructure, and post-crash care. Automotive design engineers such as Hugh De Haven and Colonel John Stapp played a prominent role in the road safety movement of the 1960s. In addition, a wide range of professionals, including physicians (Claire Straith), public health professionals (William Haddon), lawyers (Ralph Nader) and politicians (Daniel Patrick Moynihan), were involved in creating a dramatic change in road safety standards. In the USA, various individuals and institutions including those referenced above successfully lobbied Congress to pass two key laws in 1966: the National Traffic and Motor Vehicle Safety Act and the Highway Safety Act, allowing the U.S. government to play a key role in vehicle and road safety for the first time.

These legal changes led to the creation of the National Highway Safety Bureau, a precursor to the National Highway Traffic Safety Administration (NHTSA). The NHTSA along with the Federal Highway Administration (FHWA) had the mandate to regulate vehicle and highway safety standards. These two agencies played an important role in the development, implementation, and enforcement of many safety interventions, such as airbags, safety belts, an energy-absorbing steering column in steering wheels, flexible roadway signs and utility poles, deformable barriers, and safety fencing, among many others. The effects of these actions are clear in **Figure 18**, which shows that the trend of increasing road traffic crash fatalities was reversed in the US during the 1970s and has declined ever since. The legislative history and results are similar in Western Europe where today, road traffic injuries are the 31^{st} leading cause of death as opposed to the 8^{th} cause in the Latin American and Caribbean region.

The success of countries with mature economies in reducing road traffic injuries has been due to efforts in multiple areas, but assessments studying these changes suggest that improvements in vehicle engineering played a crucial role [4-6]. These improvements were driven by two mechanisms:

Vehicle design regulations provide a minimum threshold for safety performance that is required for all vehicles used in a country. Examples of such regulations are the Federal Motor Vehicle Safety Standards (FMVSS) in the USA and the UN Regulations developed by the World Forum for Harmonization of Vehicle Regulations (WP.29). These UN Regulations require vehicle manufacturers to include specific safety technologies (e.g. safety belts or head restraints) in all vehicles or to make changes to the vehicle's structural design to improve its performance in standardized crash tests.

New Car Assessment Programs (NCAPs) provide automotive safety ratings based on crash tests, and they share this information with consumers, establishing market forces to improve safety design. NCAP programs may be supported by the government, such as US NCAP, or administered by an independent non-profit organization, such as the Insurance Institute for Highway Safety (IIHS) or a combination of both, such as Euro NCAP (Europe).

NCAP testing uses test speeds and/or configurations that are slightly more stringent than those required by the UN Regulations, and some change more frequently than the UN Regulations themselves. In many markets, manufacturers compete for the best NCAP safety ratings by optimizing the way various vehicle safety technologies and structural modifications behave together as a single system to provide substantially better protection than required by the regulations. For example, all automobiles in the USA meet the side impact regulations (FMVSS 214); however, in real-world crashes, drivers of vehicles rated as good in IIHS side impact tests are 70% less likely to be killed in near-side crashes than drivers of vehicles rated as poor, even though both good and poor vehicles meet the requirements of FMVSS 214.7.

Therefore, in countries with mature economies, vehicle design regulations provided a minimum crash safety performance threshold and NCAPs created market forces that encouraged manufacturers to produce cars with improved crash resistance design. The combined effect of these mechanisms resulted in a fleet of vehicles where the average crash safety performance is substantially better than required by the regulations. Increasingly, these same types of market forces are accelerating the introduction of advanced crash avoidance technologies, such as automatic emergency braking.

In particular, Kahane et al. (2015) [4] have evaluated the evolution of overall vehicle safety in the USA by developing a vehicle risk rate that measures the degree of safety of the average vehicle relative to a vehicle on the road in 1955. The trend in this rate (**Figure 19**) shows that vehicle safety did not change much until around 1965 but has shown continued improvement since that year. The changes were gradual, as it takes a few years for the effects of the technologies used in the real world to be appreciated and several more years for vehicles equipped with the new technology to replace all the old vehicles on the road. The graph shows notable improvements beginning in the mid-1980s. This was the result of safety belt laws and their enforcement in the USA, which produced a steady increase in seat belt use from less than 50% in the 1980s to 90% in recent years, along with many other vehicle design improvements.

It is important to note that safety belts (when used) are one of the most effective safety features in passenger vehicles (**Table 9**) and they have been for many decades. Nevertheless, modern safety belts with pretensioners and load limiters, along with airbags and strong occupant compartments, now provide much higher levels of occupant protection than hip and shoulder belts alone. It is now recognized that there are safety systems that work together to provide optimal protection, as opposed to using individual safety technologies.

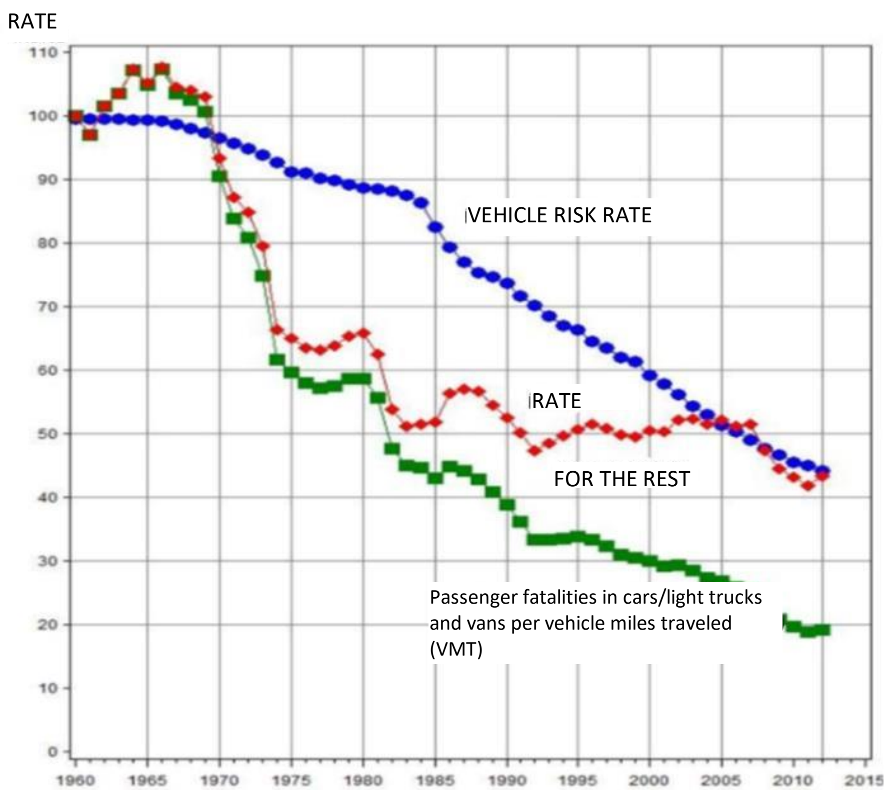


Figure 19. Role of improved vehicle engineering in reducing traffic injuries in the USA

Fuente: Kahane et al. 2015[4].

Table 9. Estimates of lives saved by safety technologies in the USA in 2012

Safety technologies	Car occupants	LTV occupants	Pedestrians, cyclists, motorcyclists	Total
105/135: Dual master cylinders & front disc brakes	217	201	65	482
108: Conspicuity tape for heavy trailers	90	70		161
126: Electronic stability control (cars and lightweight trucks)	500	824	38	1,362
201: Voluntary mid/lower instrument panel improvements Head impact upgrade	778	573		1,350
203/204: Energy-absorbing steering assemblies	1,323	1,084		2,407
206: Improved locks	486	641		1,127
208: Safety belts, of all types, in all seats	7,169	8,316		15,485
208: Frontal airbags	1,738	1,193		2,930
212: Adhesive windshield bonding	177	95		271
213: Child safety seats	213	145		357
214: Side impact protection and side airbags	1,196	315		1,512
216: Roof crush resistance	122			122
226: Ejection mitigation (rollover curtains)	3	41		43
301: Fuel system integrity: rear-impact upgrade	5	4		9
Total	**14,018**	**13,500**	**103**	**27,621**

Source: Kahane et al. 2015 [4].

Despite the many proven benefits of improved vehicle design, cars sold in the Latin American and Caribbean region continue to perform poorly in Latin NCAP crash tests. In addition, these vehicles are also not “type-certified” to the UN Regulations annexed to the 1958 Agreement and do not meet the requirements of those UN Regulations. As a result, there is great interest in encouraging regional countries to adopt automotive design standards. The World Forum for Harmonization of Vehicle Regulations (WP.29), a working group within the Inland Transport Committee of the Sustainable Transport Division of the United Nations Economic Commission for Europe (UNECE), provides a uniform global framework for the development of such regulations.

In particular, the UN Regulations annexed to the 1958 UN Agreement facilitate cross-border trade between participating countries through the reciprocal recognition of approvals granted on vehicle types. These type approvals are granted if it is proven that the vehicle meets the requirements of the respective UN Regulation. It is important to mention that the requirements of the UN Regulations are at the highest global standard with regard to their safety and emission requirements. The purpose of this part of the study is to apply mathematical models to assess the health effects (i.e. reduction of mortality and morbidity) resulting from improvements in car safety design as a result of design regulations and market forces.

CHAPTER II-2. Methods

II-2.1 Global analytical approach

The main analytical method used in this study is the concept of Comparative Risk Assessment (CRA) derived from epidemiology. A counterfactual analysis is used to assess the number of deaths (or injuries or disability burden) that could be averted in a context where safety technology is available across the entire vehicle fleet. Annex II.1 provides details on how the analysis was conducted. In simple terms, the method involves the following:

- Choose an intervention, for instance, the impact resistance design in a vehicle for pedestrian protection.
- Identify which collision configurations were impacted by the intervention. For example, impact resistance design for pedestrian protection affects injuries to pedestrians when they are hit by the front of a car.
- Identify the extent to which the intervention affects injuries in different collision configurations (relative risk) through studies that have evaluated the effects of interventions in real-world collisions. For example, studies by Strandroth et al. (2014) [7] and Pastor (2013) [8] provide estimates of the change in pedestrian injury and fatality risk due to improvements in the front-end of cars in Western Europe.
- Identify the proportion of cars in the target population that currently have the intervention. For this example, it is likely that there are no cars in the Latin American and Caribbean region that have been designed to take pedestrian safety into account.
- Identify the number of fatalities/injuries in the target population impacted by the intervention, i.e., the number of pedestrians hit by vehicles. This information is available in the collision records.
- Estimate the number of lives saved (and the burden averted) by applying the risk relative to the appropriate collision configuration.
- Relative risks (ratio of the probability of injury in crashes for the population exposed to compliant and non-compliant vehicles) were estimated based on a systematic review of the scientific literature and government reports on automobile-related risk factors.
- A more detailed analysis of the data from the literature reviews, along with the results of each technology, is presented in Chapter 5 of this part (Results). Abstracts of the relevant articles identified in the literature review are included in Annex II.2.

II-2.2 Public health burden estimate (deaths and DALYs)

Motor vehicle crashes result in fatalities and non-fatal injuries which can have long-term disability consequences. While the concept of death is easy to understand, non-fatal injuries are much more difficult to measure, in part because of the difficulty of defining clear thresholds for what constitutes a serious injury, and because it is difficult to compare the disabling consequences of an injury with disability resulting from other illnesses and diseases. As a result, in the public health field, health loss in a population due to disease and injury is measured using synthetic population health measures that combine loss of life due to death with a weighted measure of years lived with disability. Disability-Adjusted Life Years (DALYs) are the most commonly used synthetic measure and disability weights have been published that can be used to make estimates of health loss due to road traffic injuries that are directly comparable to health loss from other causes of illness and injury. Therefore, in addition to presenting estimates of lives saved, the effects on health loss in DALYs are also calculated. Annex II.1 of this study provides a description of the approach for converting estimates of fatalities and non-fatal injuries into DALYs.

II-2.3 Assessment of the effect of regulations versus market forces

Although the RPG is strongly focused on the UN Regulations, it is not possible to estimate their effect in isolation. When new UN Regulations on vehicle design are implemented, it is generally not possible to develop high-quality estimates regarding the extent of their benefits because the real-world impacts will not be known until many years later. While some technologies may appear very promising in a laboratory test, the benefits may be limited in practice. Therefore, as a general principle, this study only uses the effects of improvements in vehicle design that come from high-quality epidemiologic studies of real-world crashes with and without the design change. This limits the scope of technologies that can be evaluated, but it gives this study's estimates a much stronger empirical basis.

As discussed in the executive summary, changes in vehicle design are not influenced by regulations alone. Market forces, such as those created by NCAP programs, have a major effect on vehicle design, leading to safety performance that can far exceed the minimum thresholds required by regulations. In real-world crash studies, it is usually impossible to separate the impacts generated by regulation from those generated by market forces. As a consequence, this analysis does not attempt to isolate the effect of regulations alone. Rather, it seeks to answer the question: "How many lives would be saved if vehicles in the Latin American and Caribbean region had a similar crash safety performance to that of countries with mature economies?" while recognizing that many of these improvements were driven by market forces. An exception is the case of side impact collision, where there is evidence of a relationship between Insurance Institute for Highway Safety (IIHS) star ratings and the likelihood of a drivers' deaths in near-side impact crashes [7]. This evidence was used to illustrate the number of side impact safety improvements that can be expected in the Latin American and Caribbean region when airbags and good structural design are function as a system.

An important constraint of this analysis is that it relies on evidence from studies that measure effects in real-world road crashes. Most of the more robust evaluations focus on the effect of specific technologies. As a result, this analysis also focuses on the impact of these technologies if they were implemented in the Latin American and Caribbean region. **Table 10** shows a map of the modeled technologies and the regulations that encourage their use. It should be noted that several UN Regulations apply to the entire vehicle (e.g. Regulations No. 94 and No. 95) and do not require specific technologies (e.g. airbags), even though these technologies are commonly used to comply with such regulations.

Table 10. Modeled technologies in this analysis and UN Regulations that encourage their use

Modeled technologies	UN Regulations that encourage their use
Overall effects	All regulations
Anti-lock braking system (ABS)	UN 13-H*
Electronic Stability Control (ESC)	UN 140
Frontal airbags	UN 94
Safety belts	UN 14, UN 16, UN 94
Side airbags	UN 95, UN 135
Side structure and padding	UN 95, UN 135
Side-door impact beams	UN 95, UN 135
Head restraints	UN 17
Pedestrian protection	UN 127

Notes:

♯UN Regulation No. 14 Safety-belt anchorages; UN Regulation No. 16 Safety-belts; UN Regulation No. 17 Strength of seats and head restraints; UN Regulation No. 94 Protection of occupants: Frontal collision; UN Regulation No. 95. Protection of occupants: Lateral collision; UN Regulation No.13-H Braking systems; UN Regulation No.135 Pole side impact performance; UN Regulation No.140 Electronic Stability Control Systems; UN Regulation No.127 Pedestrian Safety.

* UN Regulation No.13H does not require ABS for the M_1 and N_1 vehicles covered by this study, but if the vehicles are equipped with ABS, they must comply with the brake system requirements of UN Regulation No.13H.

II-2.4 Sensitivity analysis

There is a high degree of uncertainty associated with the different variables of the model, including most data sources and estimates of the effectiveness of the various technologies. This implies that there is also great uncertainty in the estimates produced by the study. In order to represent the nature of this uncertainty, a set of general (average) results is provided along with a maximum and minimum range for these estimates. These are calculated as follows (see also Chapter 3 of this part: Data Sources):

- **Best estimate:** Baseline of fatalities and injuries in road traffic crashes: Based on *Global Burden Disease* (GBD)-2016 estimates.
- **Technology penetration baseline:** Based on new sales data estimated for selected countries. Average penetration values were used for the other countries in the region.
- **Relative risk:** Average value of the relative risk reported in the best study identified during the systematic review of the literature.
- **Maximum/minimum value:** The maximum and minimum values were calculated for the following combinations:
- **Baseline of fatalities and injuries due to road traffic crashes**: GBD-2016 and WHO-2016.
- **Technology penetration baseline:** Minimum and maximum value reported in the selected countries.
- **Relative risk:** Minimum and maximum value for a 95% confidence interval of the relative risk reported in the best study identified during the systematic literature review.

CHAPTER II-3. Data Sources

II-3.1 Baseline estimates of deaths and injuries

In most countries, data on road traffic fatalities and injuries are gathered and stored by road traffic police, and this police data often forms the basis of official national statistics, or as estimates based on health sector data (e.g. from national death registration systems and burden of disease studies). Data on road traffic fatalities in most countries in the Latin American region are relatively reliable, and the two main sources, the traffic police and the national death registration, are usually within 25% of each other. For instance, **Figure 20** shows the discrepancy between national official statistics (often based on police reports) in selected countries in the Latin American and Caribbean region and estimates from the global burden of disease (based on national death registration statistics in most countries in the LAC region) processed using a standardized methodology by the Institute for Health Metrics and Evaluation.

Underreporting, which varied from a minimum of 12% in Colombia to a maximum of 29% in Ecuador, is relatively low compared to other countries in the world. In China, for example, GBD estimates are five times higher than official statistics. Nonetheless, because the official estimates in all countries in the region systematically under-report the true death toll, the GBD-2016 estimates were used as the baseline data for the total number of road traffic crashes fatalities reported in this study. However, the GBD-2016 estimates are not reliable for calculating the breakdown of road user fatalities. Therefore, the GBD-2016 estimates were adjusted using the breakdown of road users provided in the official statistics reported by countries to the WHO and presented in the 2015 Global Status Report on Road Safety 2015.10

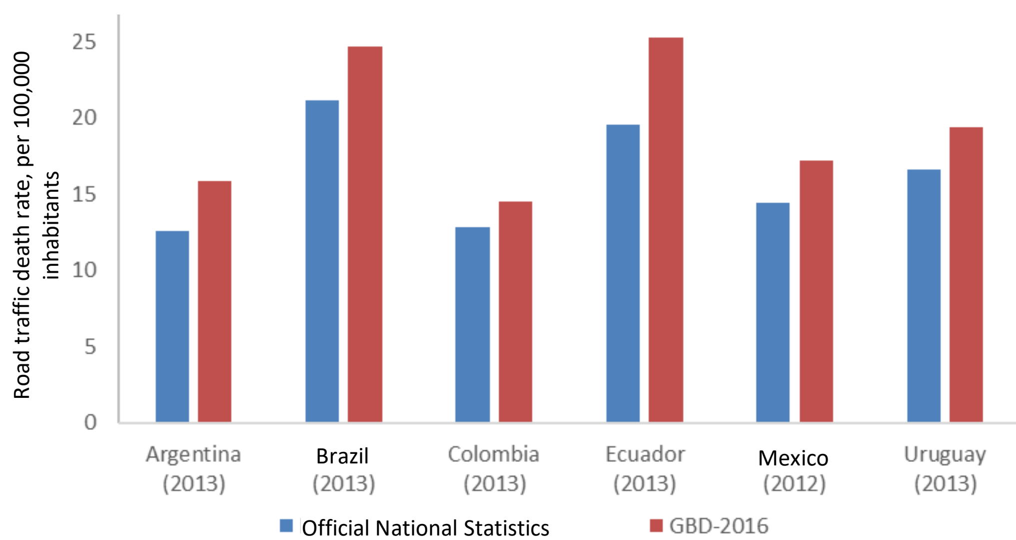


Figure 20. Underreporting of road traffic deaths in selected countries in the LAC Region

Source: Official statistics reported in the 2015 Global Status Report on Road Safety [10] and GBD-2016 [1].

Figure 21 shows the distribution of road traffic crashes fatalities by road user group in selected countries and the LAC region. The charts highlight that the distribution of road users varies substantially across the region. For instance, pedestrians account for only 10% of deaths in Argentina, but 45% in Mexico. Similarly, motorcyclists represent only 12% of deaths in Mexico and 53% in Uruguay. Vehicle safety technologies have different impacts on different road users. Therefore, one would expect large differences in how technology adoption would impact road traffic crashes fatalities and injuries across the Latin American and Caribbean region.

Unlike data on deaths, official statistics on non-fatal injuries are unreliable in most countries in the region. Even in countries with mature economies, reliable data on non-fatal injuries are not available and it is common practice to use statistical estimates based on health-sector data, while acknowledging the unreliability of these estimates. Therefore, non-fatal injury incidence estimates based on the GBD-2016 are used for this analysis.

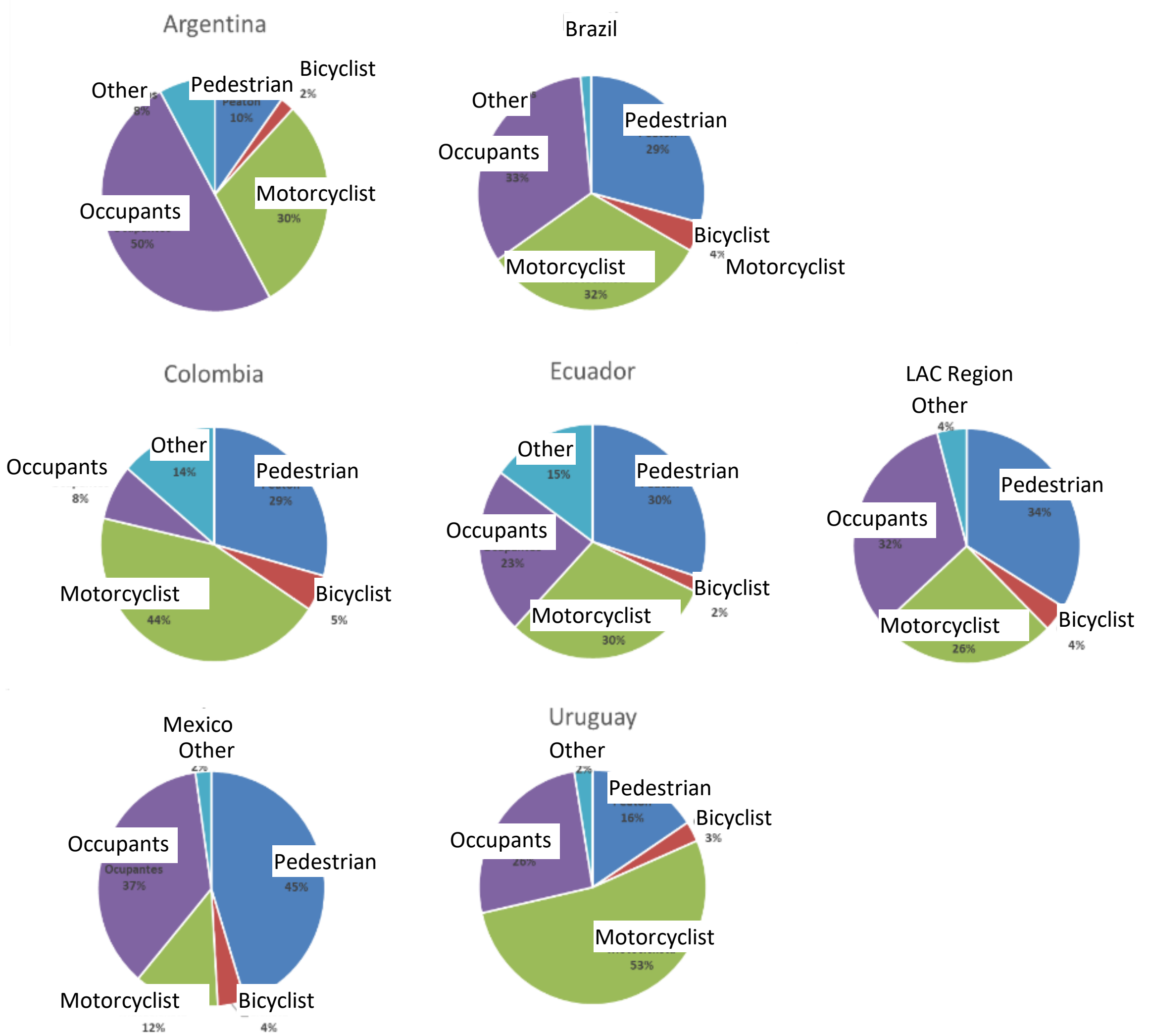


Figure 21. Proportion of different road users killed in traffic crashes in selected countries and in the Latin American and Caribbean Region

Source: The distribution of road users are from the official statistics of each country, except in Brazil, where official statistics have several "other road deaths" that are poorly specified. For Brazil, the GBD-2016 was used to gather the road user distribution information.

II-3.2 Estimates of collision configurations

The models presented here require estimating the proportion of fatalities that occur in different collision configurations. For example, while seat belts are effective in reducing the number of fatalities and injuries in frontal crashes, they have no impact on injuries caused by rear crashes. Similarly, these models require estimating the proportion of pedestrian collisions that involve cars, because pedestrian protection regulations do not apply to buses or trucks. Therefore, in order to estimate the proportion of collisions in different configurations, traffic crash statistics (such as standardized tables or collision databases) from Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, and Uruguay were used.

Collision configuration for occupants: The analysis of the data provided by the countries revealed serious problems in data quality in all the countries assessed. Problems ranged from a high rate of missing data, problems with data structure that did not allow estimating collision configurations, and biased coverage (e.g. data refer only to national highways, or to selected provinces). As a result, estimates of the proportion of occupant fatalities in various collision configurations are based on data from the USA (based on the Fatality Analysis Information System).

Impact of vehicles on pedestrians: Estimates of the impact of vehicles on pedestrians could be obtained in some countries of the region. These are shown **Figure 22**. It is notable that compared with countries with mature economies, cars account for a relatively small proportion of fatalities in the region, with a fairly large proportion of pedestrians killed by motorcycles, buses and trucks. In this analysis, data provided by the countries for this variable were used, where it is available. For the remaining countries, the average for these six countries was used (51% struck by a car). For the sensitivity analysis, the minimum and maximum values (33% and 55%) observed in these six countries were used.

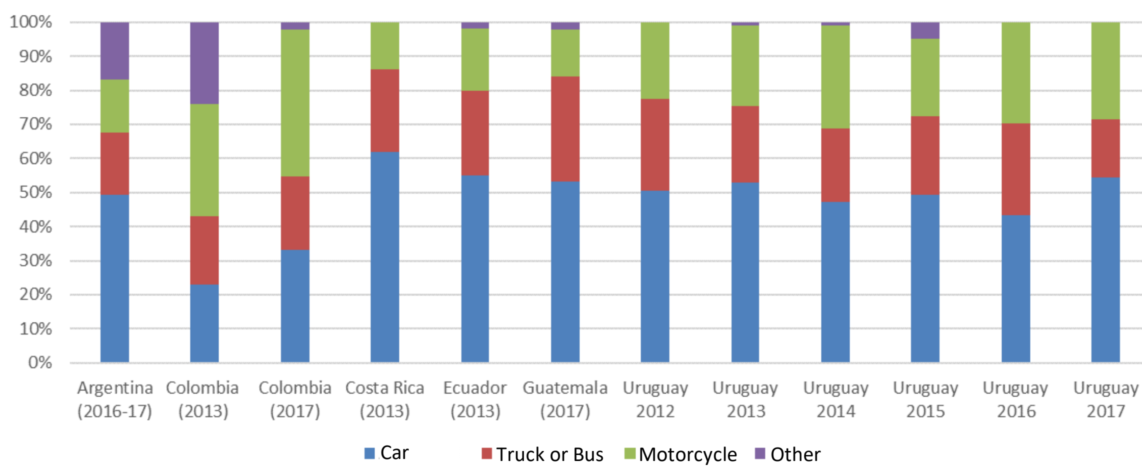


Figure 22. Proportion of pedestrian fatalities caused by various types of vehicles

II-3.3 Technology penetration in the region

Current availability of various technologies in the on-road vehicle fleet was estimated as follows. Availability of technologies in new sales was provided by AUTODATA, a consulting company specialized in automotive sector data. Data was available for three countries: Uruguay, Colombia, and Argentina (see Table). In addition, historic data regarding the presence of ABS, ESC, frontal and side airbags in new sales was available from Uruguay from 2000. Therefore, a technology adoption model was developed by adjusting a sigmoidal function to the historical data of Uruguay. It was applied to the 2017 data from

Colombia and Argentina to estimate the historic availability of these technologies in new vehicles sold in these countries. Finally, historical vehicle registration data in the three countries and a wear function (i.e. vehicle survival rates) on 1990 model year vehicles in the USA were used to estimate the availability of the technology in the on-road vehicle fleet. Data on safety belts from Colombia and Argentina suggest that they are available in about 95% of new vehicles. The data suggest that this has been the case in most countries for many years. As a result, it was assumed that most vehicles in the region have safety belts. Information on motorcycles ABS was not available from any source, but it is expected to be low. In this analysis, motorcycles ABS was assumed to be present in 0% of the fleet.

In the models presented here, national data were used for technology penetration for the countries where such data are available (i.e. Argentina, Colombia, and Uruguay). For the remaining countries, the average values of these three countries were used. For the sensitivity analysis, the minimum and maximum values of technology penetration observed in these countries were used.

Table 11. Availability of technology in new vehicles sold

Country	Year	ABS	ESC	Safety belts	Frontal Airbag	Side Airbag	Side Structure	Side Impact Beam	Head restraint
Availability of technology in new vehicles sold									
Uruguay	2012	43%	7.5%		44%	10%			
Uruguay	2017	99%	13%		91%	15%			
Colombia	2017	79%	30%	96%	79%	26%	25%	98%	91%
Argentina	2017	97%	35%	94%	96%	25%	18%	99%	90%
Technology penetration estimated as % of vehicles in use									
Uruguay	2017	50%	8%	85%	39%	8%		90%	80%
Colombia	2017	31%	15%	85%	40%	12%	10%	90%	80%
Argentina	2017	38%	17%	85%	49%	11%	6%	90%	80%
Average		40%	13%	85%	43%	10%	8%	90%	80%

Although safety belts are assumed to be available in most cars in the region, their use is estimated to be low. Thus, the performance of safety belts (to save lives) is limited not by the availability of the technology (although it is doubtful that the seat belts meet the latest technical requirements) but by use.

Therefore, estimates of the benefits of increasing belt use to 100% were modeled in this analysis. **Figure 23** shows the estimates of belt use collected from different sources. The data shown below, from the 2013 and 2015 WHO Global Status Reports on Road Safety, were provided by national experts to the WHO from various sources. Many of the estimates show unrealistically high figures for safety belt use. Therefore, data were restricted to only those countries where it could be verified that estimates of seat belt use were obtained from a nationally representative observational study (i.e. user-reported seat belt use data and single-site observational studies were excluded). These values are shown in **Table 12**. In this analysis, national data for safety-belt use were used in the countries where these data are available (i.e. those shown in the table). For the remaining countries, average values for the countries listed in **Table 11** were used. For the sensitivity analysis, the minimum and maximum values of seat belt use observed in these countries were used.

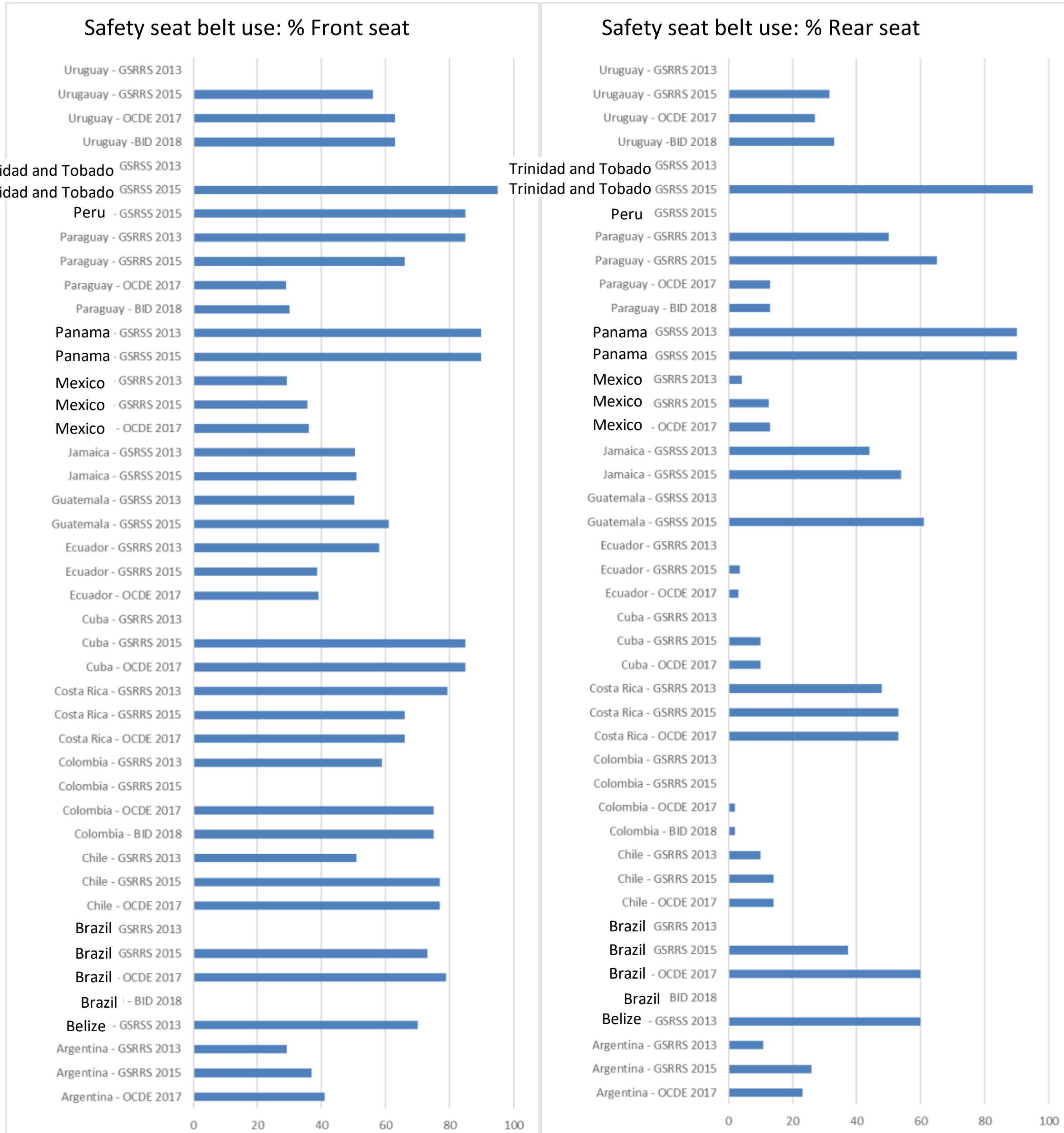


Figure 23. Estimates of safety-belt use in the region from various sources

Table 12. Estimates of the use of safety belts used as inputs in the model

Country	% Safety-belt use	Country	% Safety-belt use
Argentina	34	Guatemala	46
Chile	53	Mexico	27
Colombia	47	Paraguay	23
Costa Rica	61	Uruguay	51

CHAPTER II-4. Results

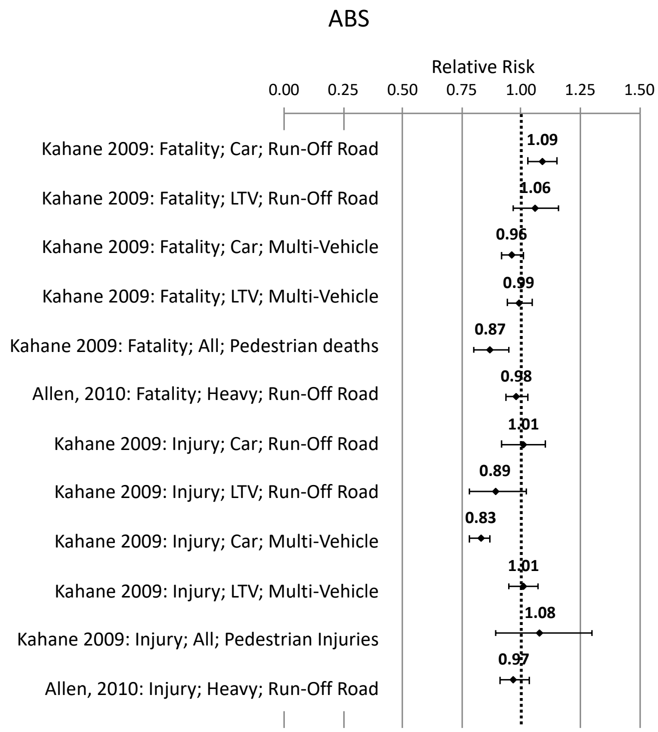
In the following sections, estimates of the impact of each technology on annual traffic crashes injuries are presented, followed by an estimate of the combined effect of vehicle safety improvements.

II-4.1 Anti-lock Braking System (ABS)

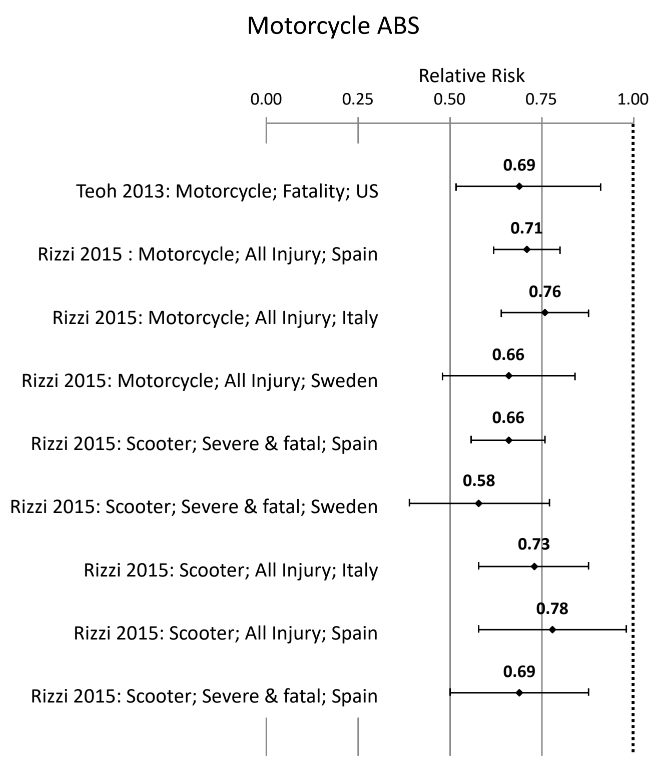
Background information

Anti-lock braking systems (ABS) are a braking technology available in both motorcycles and vehicles with 4 or more wheels. ABS use sensors to evaluate if any of the wheels are locking up during braking and reducing the braking on that wheel so it can start rolling again. Cycles of releasing, holding, and reapplying the brakes occur repeatedly. This prevents the loss of steering control due to skidding. ABS tests of passenger cars on a test track show that skidding is nearly eliminated, steering control is maintained, and stopping distance is reduced on wet roads, although stopping distances on gravel and loose surfaces are increased. Similarly, motorcycles have a substantially reduced stopping distance on a test track (on wet and dry surfaces) and the reduction in skidding means that the risk of falls should be significantly reduced.

Several studies have examined the performance of ABS in reducing fatality and injury in real-world crashes. **Figure 24** (a) shows the relative risk for ABS for cars and light tactical vehicles/vans (LTVs) reported in the studies that met the inclusion criteria of this literature review. ABS had worse results in real-world crashes than expected from track test results. Based on Kahane (2009), while there was a statistically significant 13% reduction in pedestrian deaths, fatalities associated with run-off-road deaths (especially rollovers and side impacts with fixed objects) showed a statistically significant increase of 9%. Clear benefits were observed in non-fatal collisions, with a 17% reduction in non-fatal multi-vehicle crashes. The overall effect on occupant fatalities was a slight increase that was not statistically significant, and a statistically significant decrease of 6% in all crashes. **Figure 24** (b) shows the relative risks of ABS for motorcycles reported in the studies that met the inclusion criteria of the literature review. Unlike the real-world experience of four-wheeled vehicles with ABS, the benefits of motorcycle ABS have proven to be substantial. An evaluation in the USA shows a statistically significant reduction of 31% in fatalities. ABS assessment in scooters and motorcycles in Sweden, Spain and Italy shows similar decreases that are statistically significant.



(a) Four-wheeled vehicles



(b) Two-wheeled vehicles

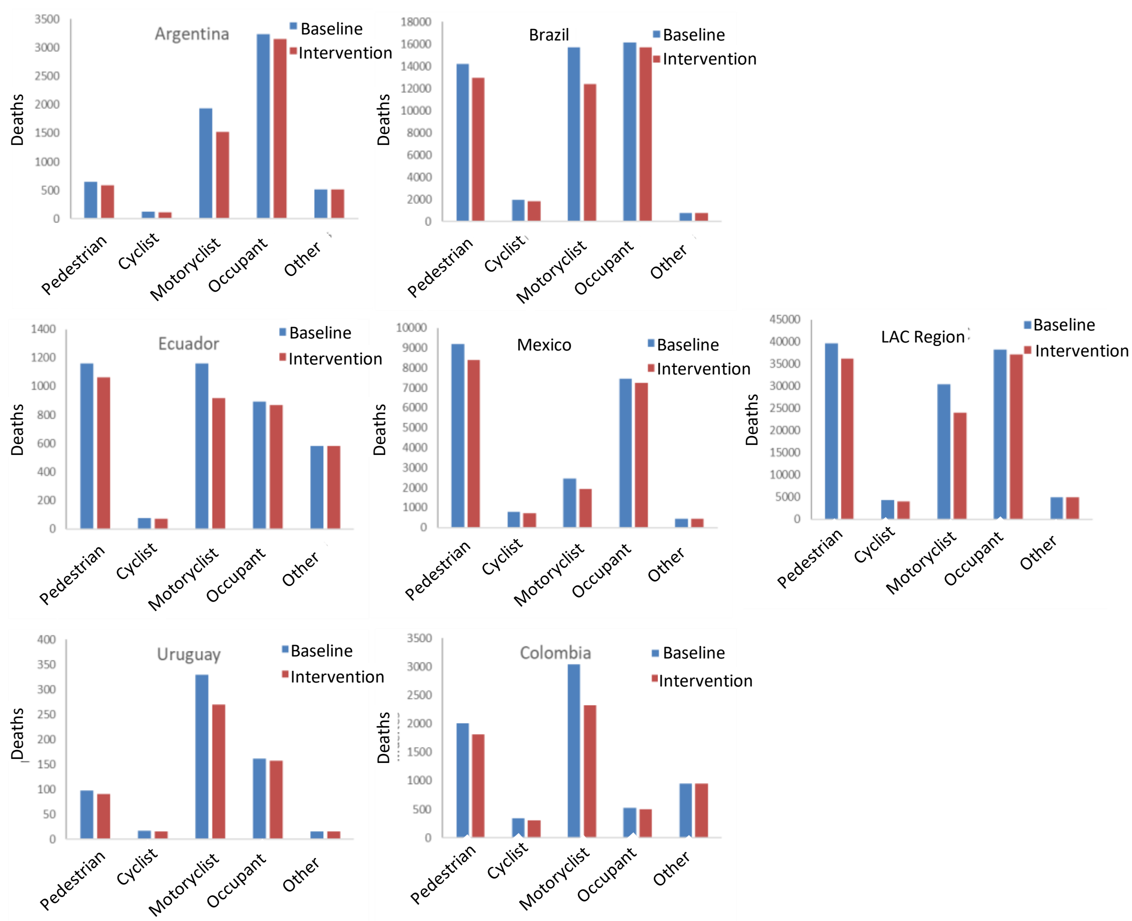
Figure 24. Relative risk and 95% confidence interval of injury associated with ABS

Estimates

[Argentina / Brazil / Ecuador / Mexico / LAC Region / Uruguay / Colombia

Baseline / Intervention
Deaths
Pedestrian/Bicyclist/Motorcyclist/Vehicle occupant/Other]

Figure *25* and **Table 13** display the expected effect of ABS on annual fatalities in selected countries in the LAC region. As expected from the preceding analysis, estimates of the reduction in fatalities are highest for motorcyclists, ranging from 18% in Uruguay to 24% in Colombia, followed by reductions in pedestrian fatalities, ranging from 7.2% in Uruguay to 9.7% in Colombia. Improvements are smaller for occupants (approximately 3%). The total lives saved annually by increasing ABS usage to 100% in the vehicle fleet ranges from 7.8% in Mexico to 14% in Colombia, and 9.6% (11,264 deaths) for the entire region. Sensitivity analysis shows that the range of these estimates is relatively wide. For the Latin American and Caribbean region as a whole, the sensitivity analysis estimates benefits ranging from a 3.1% to 17.4% reduction in the number of fatalities per year.



[Argentina / Brazil / Ecuador / Mexico / LAC Region / Uruguay / Colombia
Baseline / Intervention
Deaths
Pedestrian/Bicyclist/Motorcyclist/Vehicle occupant/Other]

Figure 25. Estimates of the impact on annual deaths in selected countries and in the Latin America and Caribbean region by increasing the use of ABS

Table 13. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to increased use of ABS

	Calculations		% Current deaths	
Lives saved	Main	Rank	Main	Rank
Argentina	578	(177-1004)	9.0%	(2.7%-15.5%)
Brazil	5147	(1599-9353)	10.6%	(3.3%-19.2%)
Colombia	964	(234-1590)	14.0%	(3.4%-23.2%)
Ecuador	377	(115-688)	9.7%	(3.0%-17.8%)
Mexico	1578	(615-2863)	7.8%	(3.0%-14.1%)
Uruguay	73	(22-153)	11.7%	(3.6%-24.6%)
LAC region	11264	(3702-20470)	9.6%	(3.1%-17.4%)

II-4.2 Electronic Stability Control (ESC)

Background information

Electronic Stability Control (ESC) systems use sensors to monitor the speed of each wheel and detect loss in traction in any one of them, and to apply brakes to individual wheels in order to help the driver maintain control of the vehicle. ESC detects oversteering (i.e. when the vehicle turns more than the driver intended when turning the steering wheel) and understeering (i.e. when the vehicle turns less than intended). ESC does this by comparing the rate of yaw (i.e. the rate of change of a vehicle's heading) to the steering wheel angle and then automatically intervenes to correct the yaw rate by applying brakes to an individual wheel. ESC is based on ABS technology and shares some of its components. All vehicles with ESC are also equipped with ABS.

Because ESC helps maintain directional stability, its primary impact is on single-vehicle run-off-road crashes, including collisions with fixed objects and rollovers. There are several high-quality studies that have consistently demonstrated the benefits of ESC in real-world crashes. The most significant effects are for rollovers. According to Kahane (2015), the decrease in rollover fatalities is statistically significant thanks to ESC with 60% less for cars and 74% less for light trucks. Other studies show similar results. The impacts are comparatively minor but consistent for multi-vehicle crashes (a statistically significant 16% for both car and LTV occupants). There is great diversity in estimates of effectiveness for single-vehicle crashes. The differences are partly explained by whether or not the study included rollovers in single-vehicle crashes. In this analysis, the estimates reported by Kahane 2015, who isolated the impacts of rollovers and other single-vehicle crashes and presented them separately, are used.

Note that ESC evaluations do not show benefits for pedestrians, but because ESC requires ABS, there are substantial advantages for pedestrians that result from the ABS components. In this analysis, the ABS benefits for pedestrians and the benefits of motorcycles ABS are shown as part of the ESC results.

Estimates

Figure 26 and **Table 14** display the expected impact of ESC on annual fatalities in selected countries in the LAC region. In addition to the considerable benefits for motorcyclists and pedestrians due to the components of ABS technology, benefits are also substantial for vehicle occupants (approximately 25%).

The total number of lives saved annually thanks to the presence of ESC ranges from 17.7% in Ecuador to 24% in Uruguay, and 19.4% (22,777 deaths) in the region as a whole (**Figure 26**). The sensitivity analysis shows that the range of these estimates is relatively wide, but even the most pessimistic estimates of benefits are considerable. For the region as a whole, models estimate a reduction in fatalities between 8.6% to 31.1%.

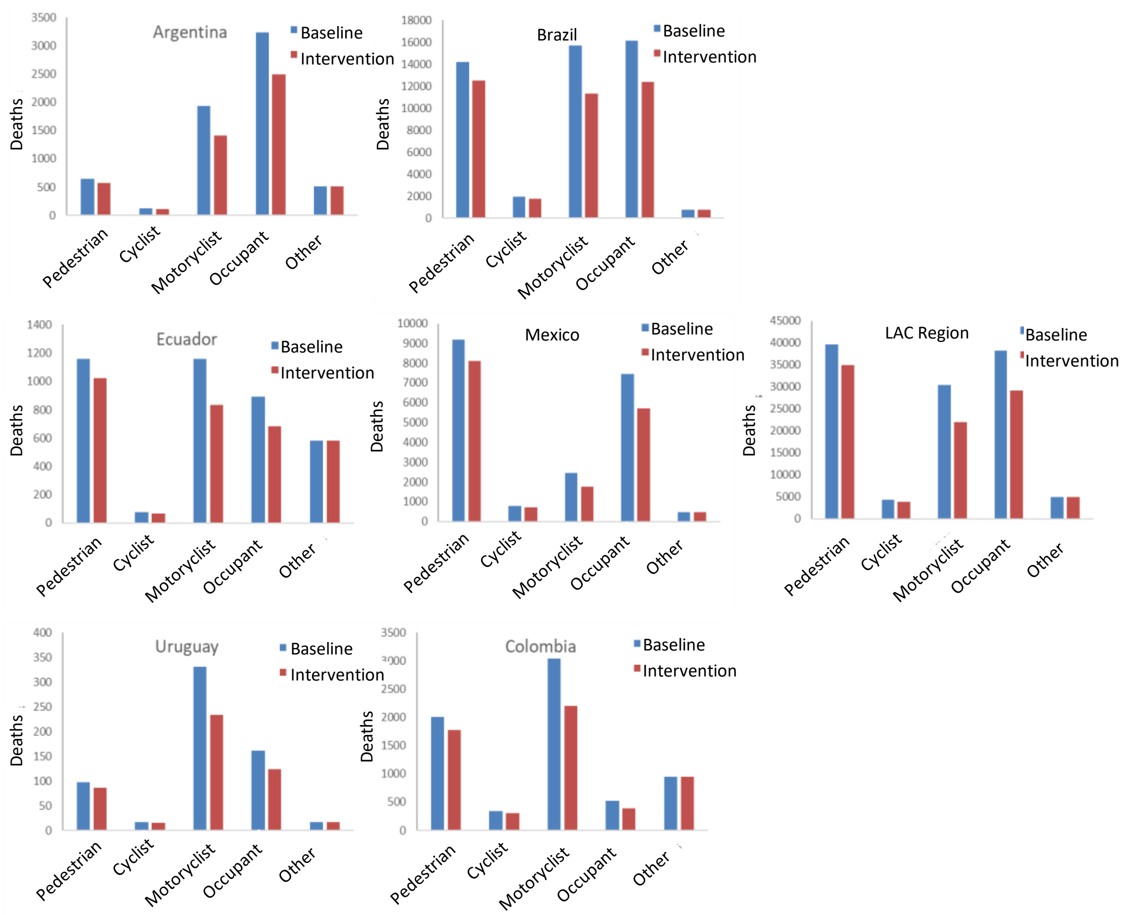


Figure 26. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of ESC

Table 14. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to increased use of ESC

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	1349	(631-2195)	20.9%	(9.8%-34.0%)
Brazil	10076	(4230-16106)	20.7%	(8.7%-33.1%)
Colombia	1242	(442-2086)	18.1%	(6.4%-30.4%)
Ecuador	683	(280-1105)	17.7%	(7.2%-28.5%)
Mexico	3632	(1789-5822)	17.8%	(8.8%-28.6%)
Uruguay	149	(52-230)	24.0%	(8.3%-36.9%)
LAC Region	22777	(10052-36576)	19.4%	(8.6%-31.1%)

II-4.3 Safety belts

Background information

Safety belts are the most basic and important safety feature for vehicle occupants. In a crash, unbelted occupants will continue to move at the speed the vehicle was traveling and are thrown against the structure of the car. For the driver, this means an impact against the steering wheel, windshield and dashboard. Safety belts absorb energy from the occupants during sudden deceleration and deformation of the vehicle. They also reduce the risk of occupant contact with the vehicle structures. Safety belts distribute the forces over the strongest parts of the body and prevent the occupant from being ejected from the vehicle. As shown in **Figure 27**, evaluations of the safety benefits of safety belts in real-world crashes show that there is a statistically significant decrease in death probability (50%) and in serious injury (45%) for drivers wearing safety belts. Safety belts provide similar benefits for front seat passengers (Elvik, 2004).

As explained in Chapter 3, almost all cars in the region already have safety belts, leaving the question of whether they are equipped with the latest versions. Nonetheless, the technology does not offer any benefits if it is not used. Safety-belt use in the region remains low. Therefore, in the case of this technology, this analysis models the impact of increased safety-belt use (i.e. as opposed to increased safety-belt availability in cars). An additional problem may be whether or not these safety belts are built with the latest technical innovations that make them more effective.

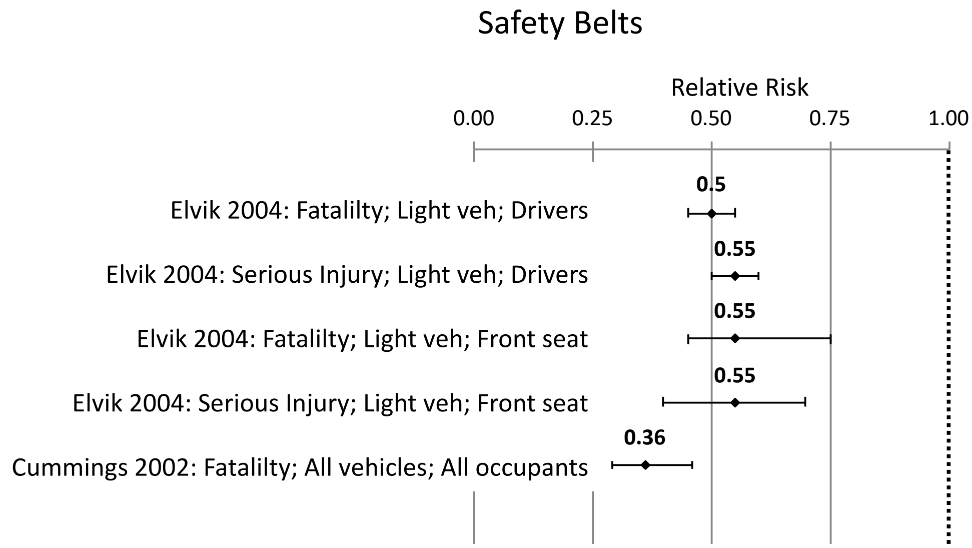


Figure 27. Relative risk and 95% confidence interval of injury associated with safety belts

Estimates

Figure 28 and **Table 15** display the expected impact of increased safety-belt use on annual deaths in selected countries and in the LAC region. Since safety belts only protect vehicle occupants, an increased use of safety belts has no effect on deaths of other road users. However, the benefits for occupants are considerable and the decrease in occupant fatalities range from 32% to 40%, depending on the actual use of safety belts in the country. For the region as a whole, the number of occupant fatalities would be reduced by 37% if safety belts were used in 100% of cases.

The total number of lives saved annually by increasing safety-belt use depends on the proportion of vehicle occupant fatalities in each country. The greatest improvement would occur in Argentina (19.9% fewer fatalities from traffic crashes), where the occupants constitute the largest proportion of fatalities and where use of safety belts is relatively low. In contrast, the lowest benefit is found in Colombia (2.4%), where vehicle occupants make up a small proportion of the total number of fatalities in traffic crashes. For the region as a whole, the number of fatalities (14,186 deaths) would decrease by 12.1% if safety-belt use were increased, with a range of 9.1% to 15.5% according to the sensitivity analysis.

It is important to note that safety belts are a highly effective technology and they are generally available in these countries, but the region cannot benefit from this feature unless it is used. Increasing and maintaining high rates of safety-belt use in a population requires that policymakers take a comprehensive approach that depends on legislation and enforcement of safety-belt use, as well as technical standards for safety-belt performance, public education, and advertising. Effective programs have a firm foundation in deterrence theory and create a climate of deterrence such that people believe they are likely to be detected and punished for breaking the law regarding safety belts.

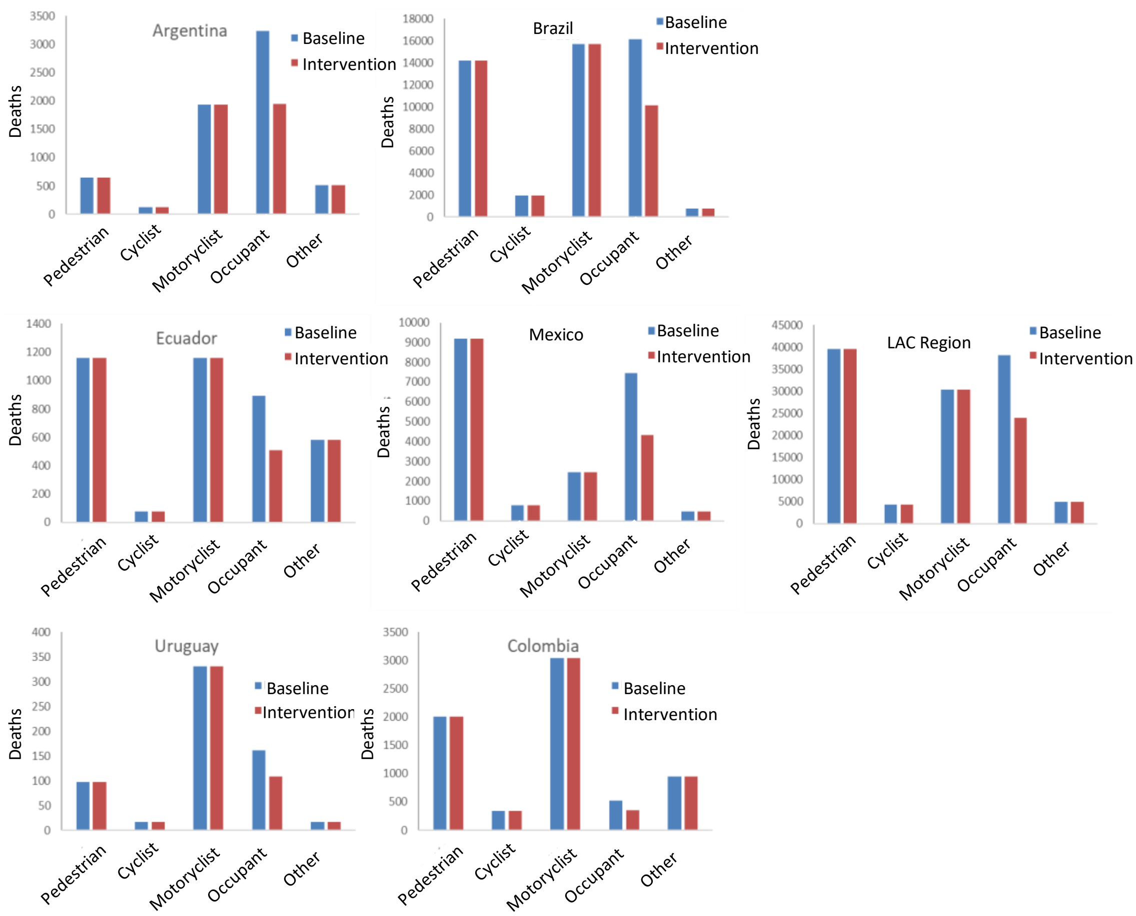


Figure 28. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of safety belts

Table 15. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of safety belts

	Calculations		% Current deaths	
Lives saved	Main	Rank	Main	Rank
Argentina	1284	(900-1543)	19.9%	(13.9%-23.9%)
Brazil	5990	(4492-7701)	12.3%	(9.2%-15.8%)
Colombia	167	(145-249)	2.4%	(2.1%-3.6%)
Ecuador	381	(248-425)	9.8%	(6.4%-11.0%)
Mexico	3139	(2076-3558)	15.4%	(10.2%-17.5%)
Uruguay	53	(45-77)	8.5%	(7.2%-12.4%)
LAC Region	14186	(10639-18239)	12.1%	(9.1%-15.5%)

II-4.4 Frontal Airbags

Background information

Frontal airbags provide an effective protection system that complements safety belts and other energy-absorbing systems, such as energy-absorbing steering columns, deformable instrument panels and the vehicle structure, including the energy absorbed by the vehicle's deformation. Airbags also reduce the risk of contact between the occupant and the vehicle interior. Three generations of frontal airbags have been produced in the USA. Airbags were initially designed for unbelted dummies in crashes against a rigid barrier. Evaluations of these airbags showed that they posed a risk to some occupants, especially children. Second-generation airbags mitigated this risk by deploying less force and were developed in response to a change in regulatory testing procedures. Advanced or two-stage frontal airbags, which were standard in the USA for model year 2007, detect whether they need to be deployed at full force, reduced force, or not deploy at all, minimizing injury to children and adults of short stature. **Figure 29** shows that airbags in the USA reduce the probability of death by a statistically significant 29% and the probability of non-fatal injury by 27% (Kahane 2015).

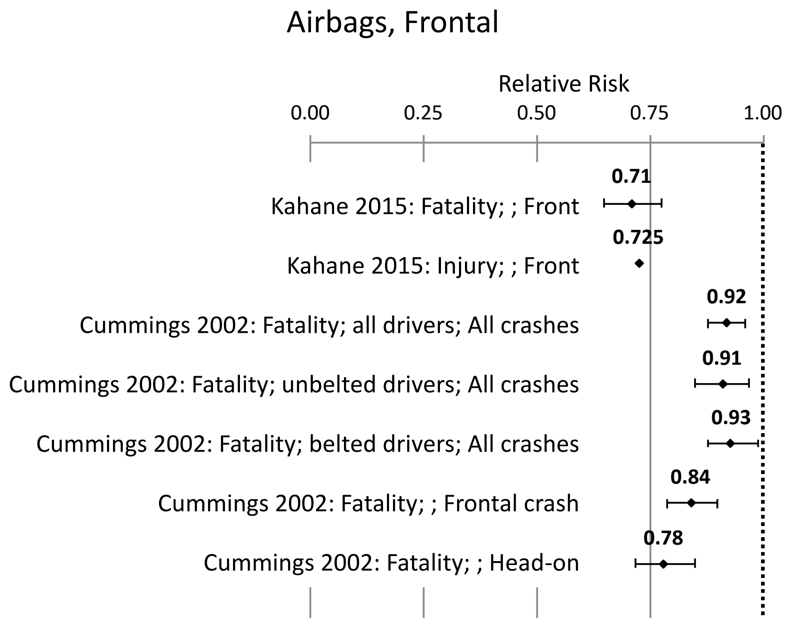


Figure 29. Relative risk and 95% confidence interval of injury associated with frontal airbags

Estimates

Figure 30 and **Table 16** display the expected impact of increased availability of frontal airbags on annual fatalities in selected countries and in the LAC region. As with safety belts, airbags only protect vehicle occupants, thus countries where occupants are the group with the greatest number of injuries will have the greatest benefits. Major estimates show reductions in the number of occupant fatalities, ranging from 9.9% in Argentina to 11.4% in Uruguay. The region as a whole would reduce its number of occupant fatalities by 10.8%.

The total number of lives saved annually due to the increased availability of frontal airbags, combined with the proper behavior of the vehicle structure, ranges from 4.9% in Argentina, which has the highest proportion of occupant fatalities, to 0.9% in Colombia, where occupants constitute the lowest proportion of fatalities. In the region as a whole, the number of total fatalities would decrease by 3.5% (4,126 deaths), with a range of between 2.3% and 4.3% according to the sensitivity analysis.

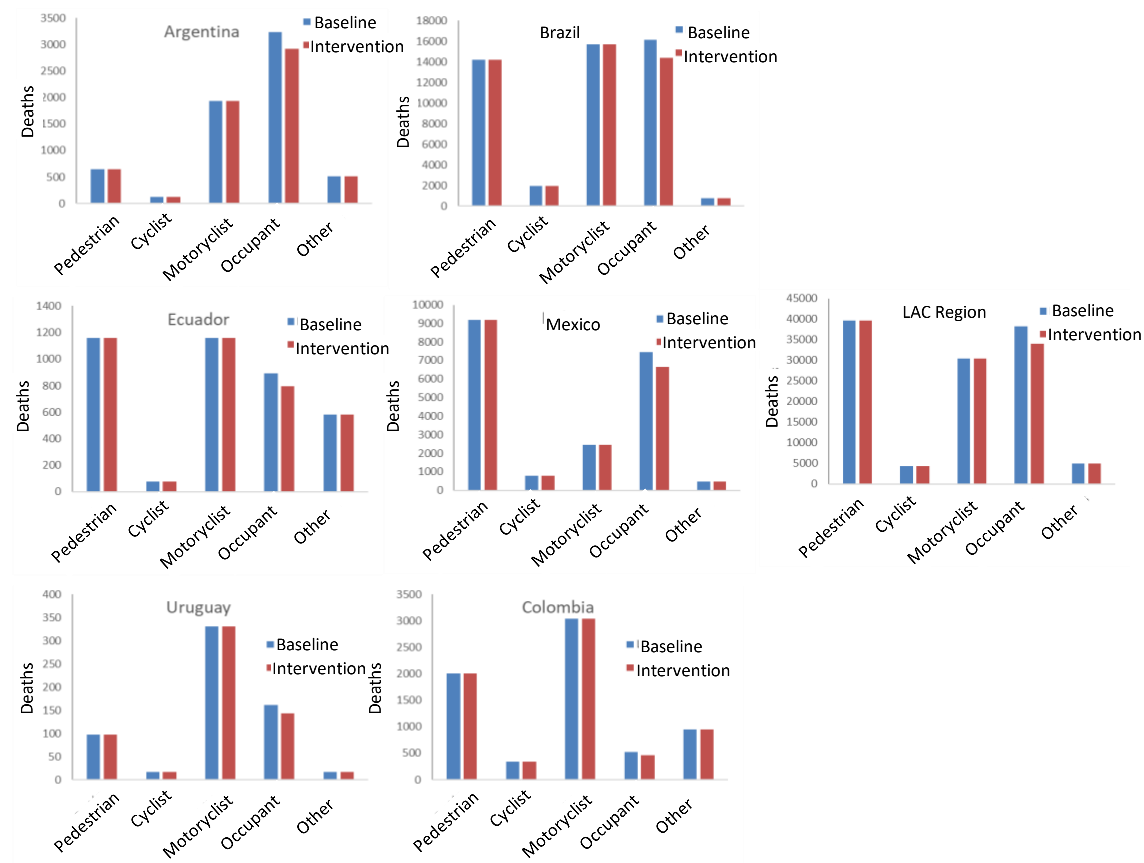


Figure 30. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of frontal airbags

Table 16. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of frontal airbags

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	319	(225-431)	4.9%	(3.5%-6.7%)
Brazil	1742	(1123-2153)	3.6%	(2.3%-4.4%)
Colombia	59	(36-70)	0.9%	(0.5%-1.0%)
Ecuador	96	(62-119)	2.5%	(1.6%-3.1%)
Mexico	805	(519-995)	4.0%	(2.5%-4.9%)
Uruguay	18	(11-22)	3.0%	(1.8%-3.5%)
LAC Region	4126	(2660-5099)	3.5%	(2.3%-4.3%)

II-4.5 Side Airbags

Background information

While passenger vehicles often have significant deformation zones in the front, there is little space on the sides to absorb the forces of an impact. Like frontal airbags, side airbags work by providing a cushion in the event of a lateral impact. However, side airbags inflate faster because there is less space between the occupant and the impacting object. Side airbags are designed to distribute impact forces over a larger area of the human body and also to minimize contact with the vehicle’s interior and objects that invade the cabin. Torso airbags commonly deploy from the door trim or the side of the seatback. While these provide torso protection, they do not protect the head, although there are a few combination airbags which protect the torso and the head and deploy from the seat. Curtain airbags, which are typically deployed from above the window, protect the head from impact against the rigid interiors of the car (such as the A-pillar and window frame). They also provide some protection against ejection of the occupant from the side window. Curtains and torso airbags provide the most comprehensive protection.

As shown in **Figure 31**, several studies have demonstrated the significant benefits of side airbags, especially those with head protection, in collisions involving a lateral impact. McCartt (2007) demonstrated that airbags with head protection statistically significantly reduced near-side impact fatalities by 52%.

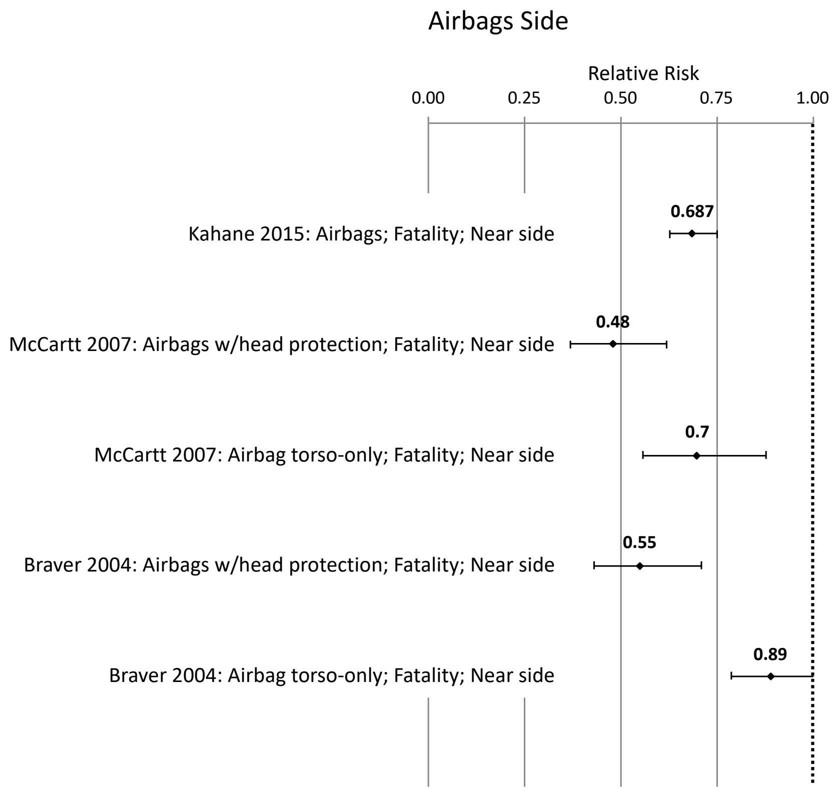


Figure 31. Relative risk and 95% confidence interval of injury associated with side airbags

Estimates

Figure 32 and **Table 17** display the expected impact of increasing the availability of side airbags with head and torso protection on annual deaths in selected countries and in the LAC region. Like other occupant-protection technologies (e.g. safety belts, frontal airbags), airbags only protect occupants and, therefore, have a greater benefit in countries where occupants account for a large proportion of deaths. Estimates show a decrease in occupant mortality of about 9% in the selected countries and in the region as a whole.

The total number of lives saved annually due to increased availability of side airbags with head and torso protection, combined with appropriate vehicle side structure behavior, ranges from 4.3% in Argentina, which has the highest proportion of occupant fatalities, to 0.6% in Colombia, where occupants constitute the lowest proportion of fatalities. In the region as a whole, the total number of fatalities would decrease by 2.8% (3,301 deaths), with a range between 2.1% and 3.4% according to the sensitivity analysis.

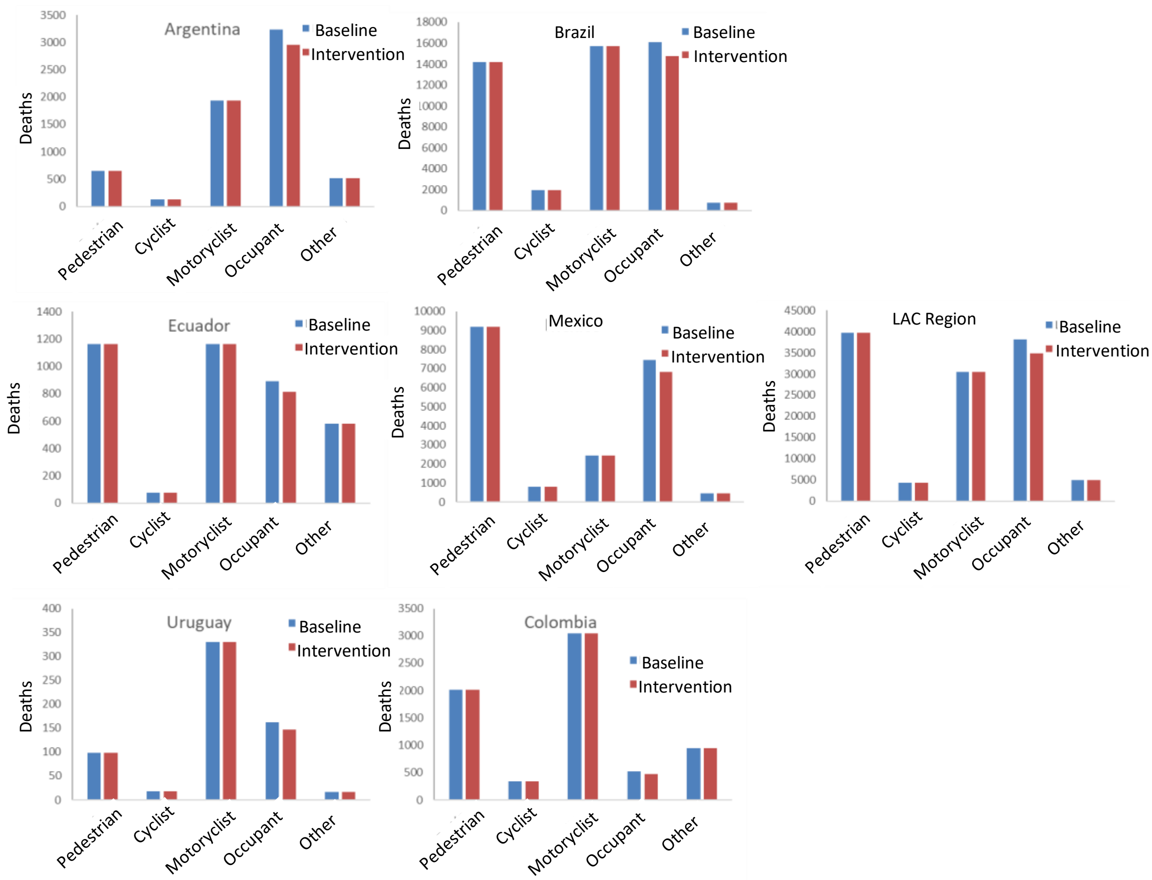


Figure 32. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of side airbags

Table 17. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of side airbags

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	277	(214-339)	4.3%	(3.3%-5.2%)
Brazil	1394	(1066-1691)	2.9%	(2.2%-3.5%)
Colombia	44	(34-55)	0.6%	(0.5%-0.8%)
Ecuador	77	(59-93)	2.0%	(1.5%-2.4%)
Mexico	644	(492-782)	3.2%	(2.4%-3.8%)
Uruguay	14	(11-17)	2.3%	(1.7%-2.7%)
LAC Region	3301	(2524-4006)	2.8%	(2.1%-3.4%)

II-4.6 Side-door impact Beam

Background information

In a poorly designed car, the side doors may be empty shells made of sheet metal that offer no structural resistance in a crash. Side door beams that run horizontally through the door were initially developed in the 1960s to provide some structural integrity, but they have little support and offer little resistance in a high-speed crash with another vehicle. However, these beams have proven to be quite effective in collisions with a fixed object where the impact has is mostly frontal. In such impacts, instead of absorbing the energy of the crash, the beam acts somewhat like a highway guard rail deflecting the object. Kahane (2015) (**Figure 33**) considered that side door crash beams reduce fatalities in single vehicle side impacts by 14% (which is statistically significant).

Estimates for far side impacts were similar. This is a small impact in a relatively rare crash configuration. Furthermore, it is important to note that data on technology penetration in the region suggests that side door beams are already available in 90% of the vehicle fleet. Thus, additional benefits associated with this technology are likely to be small.

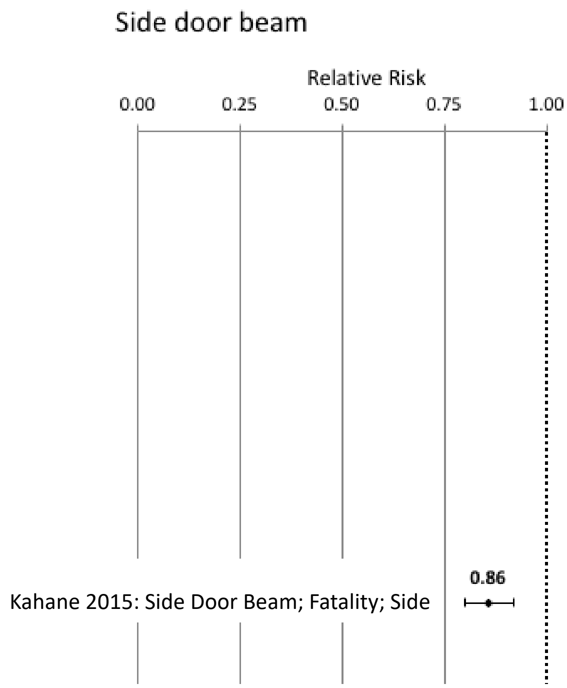


Figure 33. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of side door impact beams

Estimates

Figure 34 and **Table 18** show the expected impact of increasing the availability of side door impact beams on annual deaths in selected countries and in the LAC region. The main estimates show reductions in occupant mortality of less than 0.5% in the selected countries and in the region as a whole. The total lives saved annually by increasing the availability of side door impact beams to 100% of the vehicle fleet is lower, less than 0.2% in the selected countries and 0.1% (157 deaths) in the LAC region as a whole.

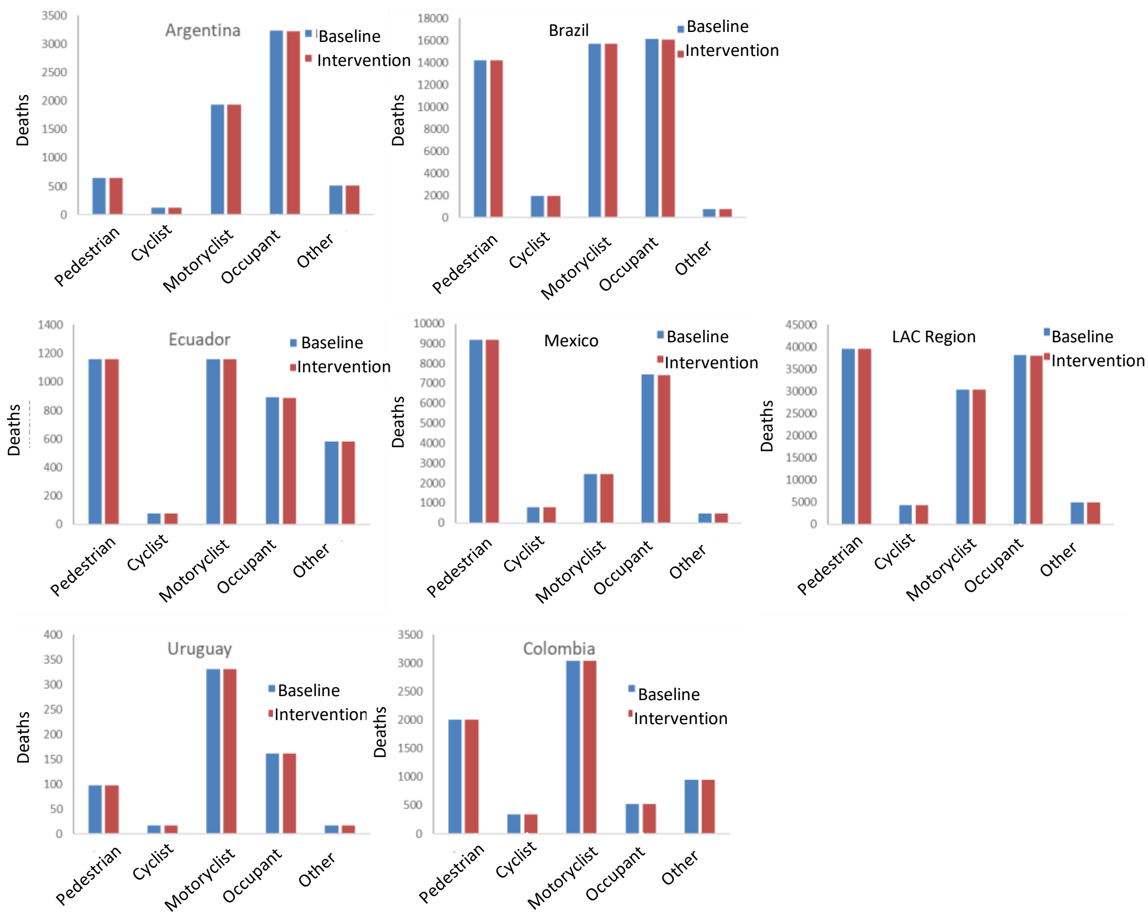


Figure 34. Relative risk and 95% confidence interval of injury associated with side door impact beams

Table 18. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of side door impact beams

	Calculations		% Current deaths	
Lives safed	Main	Rank	Main	Rank
Argentina	13	(7-20)	0.2%	(0.1%-0.3%)
Brazil	66	(34-100)	0.1%	(0.1%-0.2%)
Colombia	2	(1-3)	0.0%	(0.0%-0.0%)
Ecuador	4	(2-5)	0.1%	(0.0%-0.1%)
Mexico	31	(16-46)	0.2%	(0.1%-0.2%)
Uruguay	1	(0-1)	0.1%	(0.1%-0.2%)
LAC region	157	(81-236)	0.1%	(0.1%-0.2%)

II-4.7 Side structure and padding

Background information

The insufficiency of side door impact beams in resisting a high-speed side impact with another vehicle was already evident to engineers in the 1970s. However, it was found that two technologies could substantially help mitigate thoracic injuries to occupants involved in side impacts. The first was to considerably strengthen the structures that could resist intrusion, including pillars, roof rails, and cross-members, and increased overlap between doors and pillars. The second technology was the inclusion of energy-absorbing padding in the door cavity to provide cushion during impact. According to Kahane (2015), these modifications combined have reduced the risk of fatalities in side impacts of all types by 21% (**Figure 35**). These are relatively important effects. In addition, as described in Chapter 3, available data suggest that the availability of side structure and padding in vehicles in the region remains relatively low.

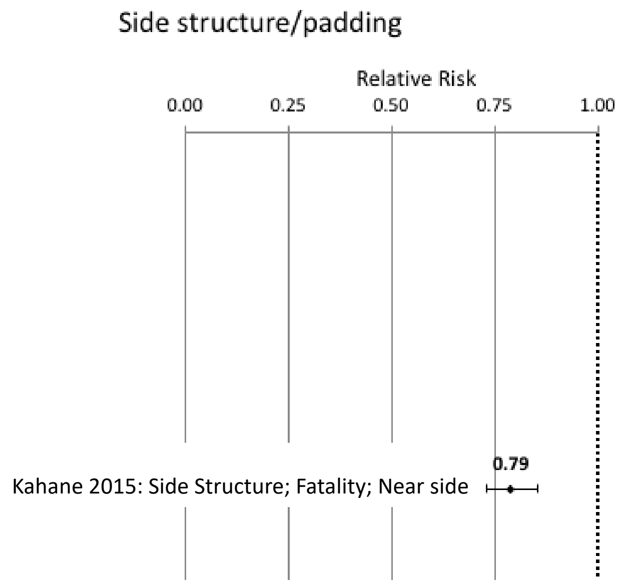


Figure 35. Relative risk and 95% confidence interval of injury associated with side structure and padding

Estimates

Figure 36 and **Table 19** illustrate the expected impact of side structures and padding on annual deaths in selected countries and in the LAC region. The main estimates show reductions in occupant mortality of approximately 5% in the selected countries and in the region as a whole.

The total lives saved annually due to the increased availability of side structures and padding ranges from 2.5% in Argentina, which has the highest proportion of occupant fatalities, to 0.4% in Colombia, where occupant fatalities constitute the lowest proportion. In the region as a whole, the total number of fatalities would decrease by 1.6% (1,876 deaths), with a range between 2.1% and 1.6% according to the sensitivity analysis.

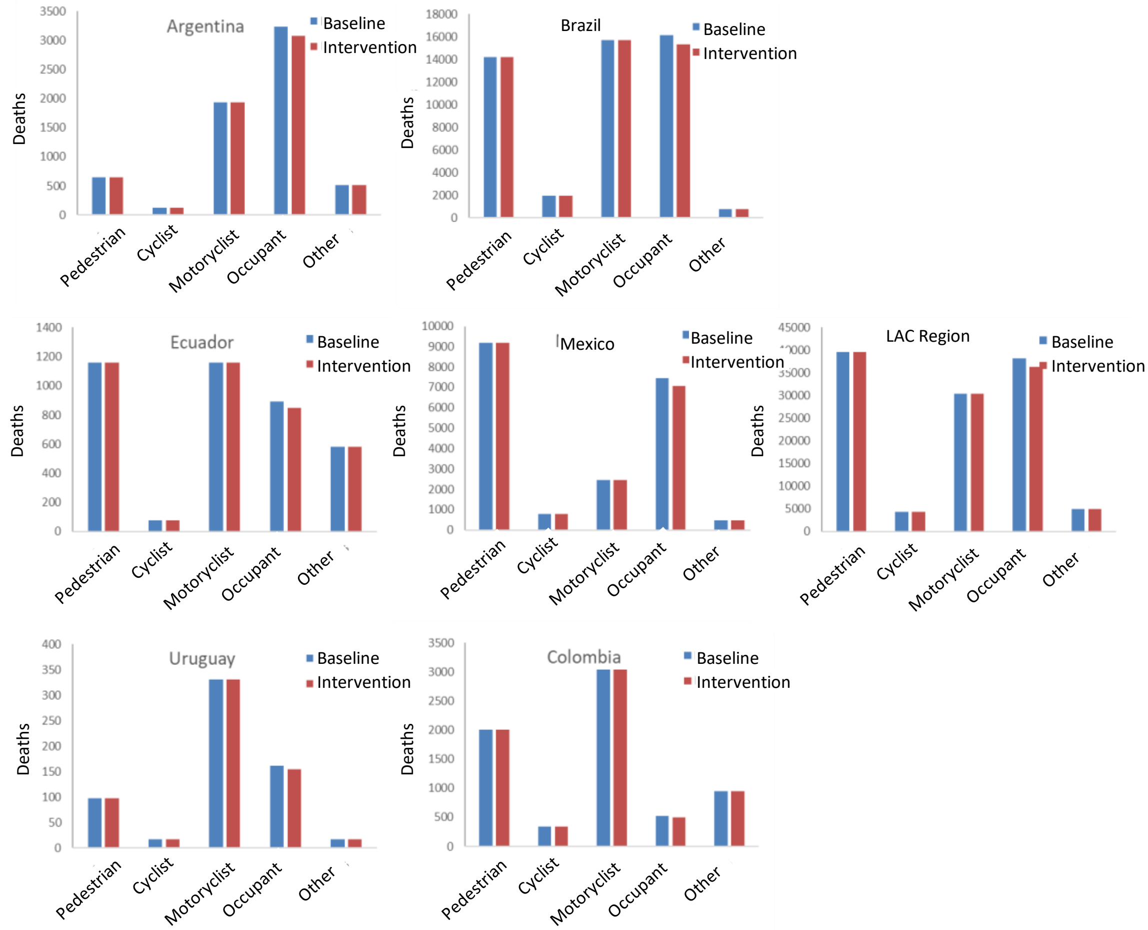


Figure 36. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of side structure and padding

Table 19. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of side structure and padding

	Calculations		% Current deaths	
Lives saved	Main	Rank	Main	Rank
Argentina	162	(107-208)	2.5%	(1.7%-3.2%)
Brazil	792	(534-1040)	1.6%	(1.1%-2.1%)
Colombia	25	(17-34)	0.4%	(0.3%-0.5%)
Ecuador	44	(29-57)	1.1%	(0.8%-1.5%)
Mexico	366	(247-481)	1.8%	(1.2%-2.4%)
Uruguay	8	(5-10)	1.3%	(0.9%-1.7%)
LAC Region	1876	(1264-2463)	1.6%	(1.1%-2.1%)

II-4.8 Optimized system for side impact protection

Background information

New car assessment programs (NCAPs) create a strong incentive for manufacturers to improve the protection offered by cars. While regulations create a minimum threshold of safety performance, star ratings of NCAPs allows consumers to differentiate between different models and encourages manufacturers to achieve the highest ratings. In this analysis, it has not been possible to isolate the effect of regulations from these market forces. However, a study by Teoh and Lund (2011) provides an opportunity to assess the effect of NCAP programs crashworthiness protection in side impacts.

In the USA, side crash test ratings provided by the Insurance Institute of Highway Safety (IIHS) are based on a test in which a vehicle is impacted perpendicularly on the driver's side by a moving deformable barrier simulating a crash with a typical sport utility vehicle or light truck.

There is evidence that vehicle manufacturers responded to IIHS ratings by redesigning cars to get better ratings. In 2003, when this testing program began, only 17% of vehicles earned a good rating but by 2007, more than half of tested vehicles did, and by 2010, every vehicle earned a good rating. Teoh and Lund (2011) assessed whether these improvements in ratings in a laboratory environment corresponded to an improvement in safety in real-world crashes. Using crash data from the USA, they show that drivers of vehicles rated as good (highest rating) by IIHS were 70% less likely to die when involved in nearside crashes than drivers of vehicles rated as poor (lowest rating). The impact was statistically significant. It should be noted that all of the vehicles included in the study had airbags. Therefore, the primary benefit is derived from improvements in structural performance, i.e. the better cars were designed to ensure that airbags worked together with other design features to optimize occupant protection as assessed by NCAPs.

Estimates

In **Figure 37** and **Table 20** the intended impact of upgrading all cars to "good" quality is presented. To do this, the improvements that came from the installation of airbags were estimated first. Then, it is assumed that if there were no NCAP program these vehicles would receive a "poor" star rating in the IIHS tests. The relative risks (good versus poor) estimated by Teoh and Lund (2011) were then applied.

The expected impacts are considerable. Optimizing protection against side impacts has led to a reduction in occupant fatalities of about 19% in the selected countries and in the region as a whole. Estimates of total lives saved annually range from 9.7% in Argentina, which has the highest proportion of occupant fatalities, to 1.5% in Colombia, where occupant fatalities are the lowest proportion. In the region as a whole, total fatalities would decrease by 6.3% (7410 deaths), with a range of 4.1% to 6.5% according to the sensitivity analysis.

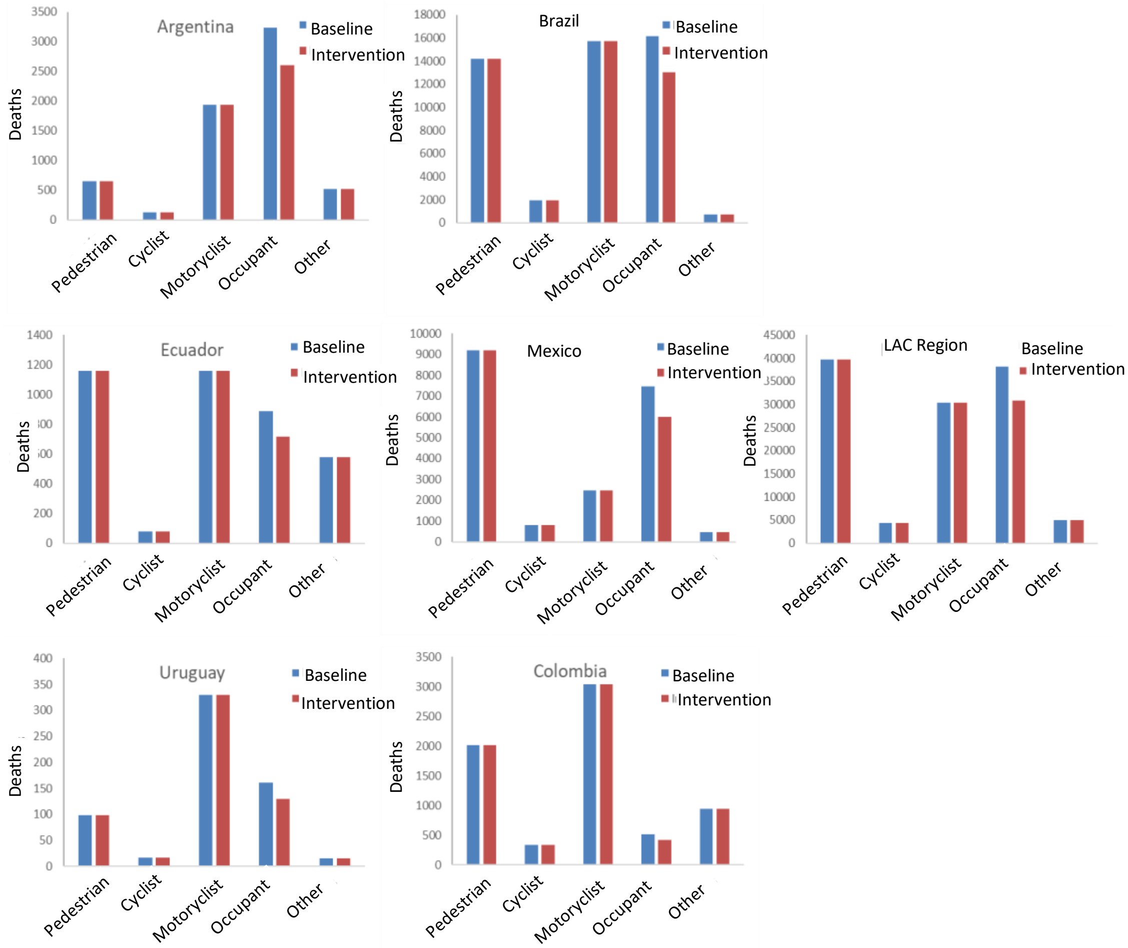


Figure 37. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of optimized systems for side impact protection

Table 20. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of optimized systems for side impact protection

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	625	(409-645)	9.7%	(6.3%-10.0%)
Brazil	3129	(2040-3218)	6.4%	(4.2%-6.6%)

Colombia	101	(66-104)	1.5%	(1.0%-1.5%)
Ecuador	173	(113-178)	4.5%	(2.9%-4.6%)
Mexico	1446	(943-1487)	7.1%	(4.6%-7.3%)
Uruguay	31	(20-32)	5.1%	(3.3%-5.2%)
LAC Region	7410	(4832-7621)	6.3%	(4.1%-6.5%)

II-4.9 Head restraints

Background information

The purpose of head restraints is to reduce the risk of neck injuries to occupants in rear-end collisions. Whiplash injury results from damage to the soft tissue and vertebrae of the neck due to the head jerking backwards and then forward after a rear-end impact. Whiplash injury typically results in pain in the neck, upper back, arms and shoulders, and may lead to headaches, and sight or hearing disorders. As shown in **Figure 38**, head restraints in cars reduce non-fatal injuries by a statistically significant 17%. However, there is no impact on the number of fatalities.

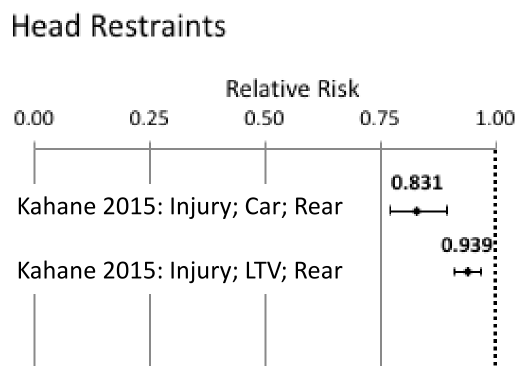
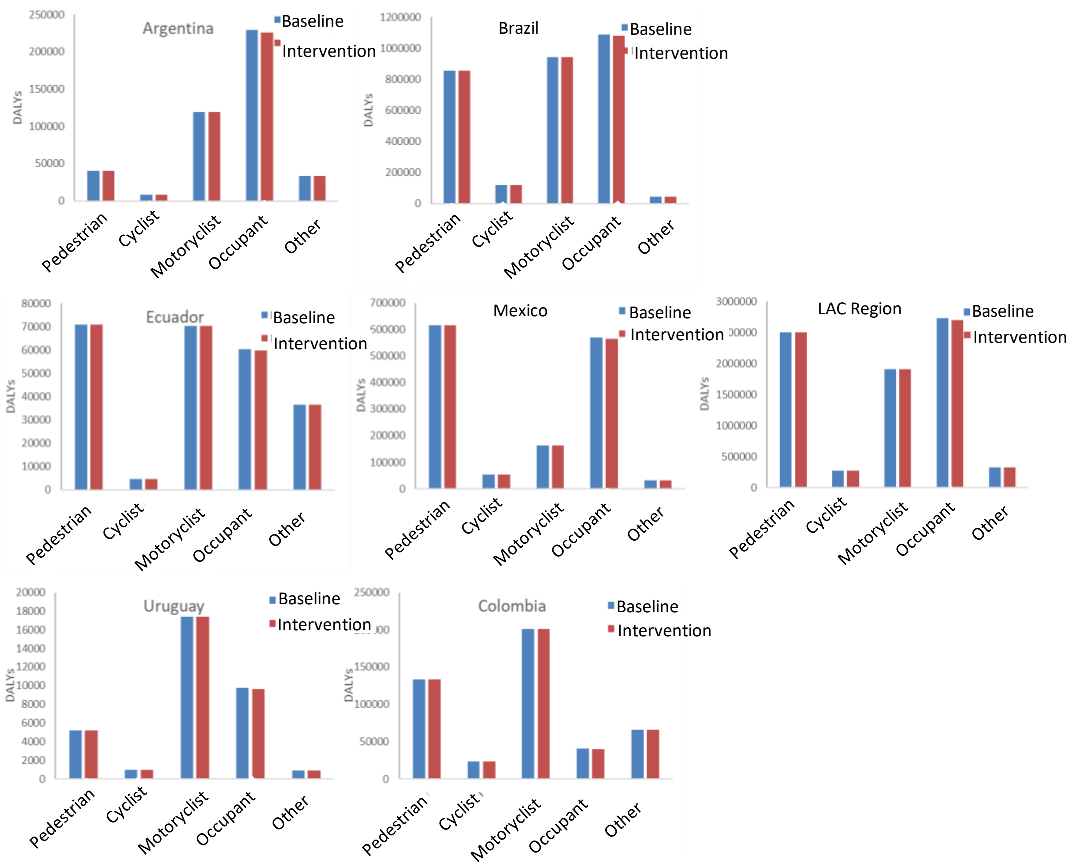


Figure 38. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by increasing the use of head restraints

Estimates

Figure 39 and **Table 21** show the expected impact of head restraints on annual deaths in selected countries and in the LAC region. The results are zero because head restraints have no impact on fatalities.

Figure 40 and **Table 22** present the same results for non-fatal injuries. The estimates are lower, mainly because most vehicles in the region already have head restraints. The main estimate shows a 1.6% reduction in non-fatal injuries in Argentina and only 0.2% in Colombia. The region as a whole would have 1.0% fewer non-fatal injuries, ranging from 0.6% to 1.4% according to the sensitivity analysis.


Argentina
Brazil
Ecuador
Mexico
LAC Region
Uruguay
Colombia
Baseline
Intervention
DALYs
Pedestrian
Cyclist
Motorcyclist
Occupant
Other

These impacts are even lower (

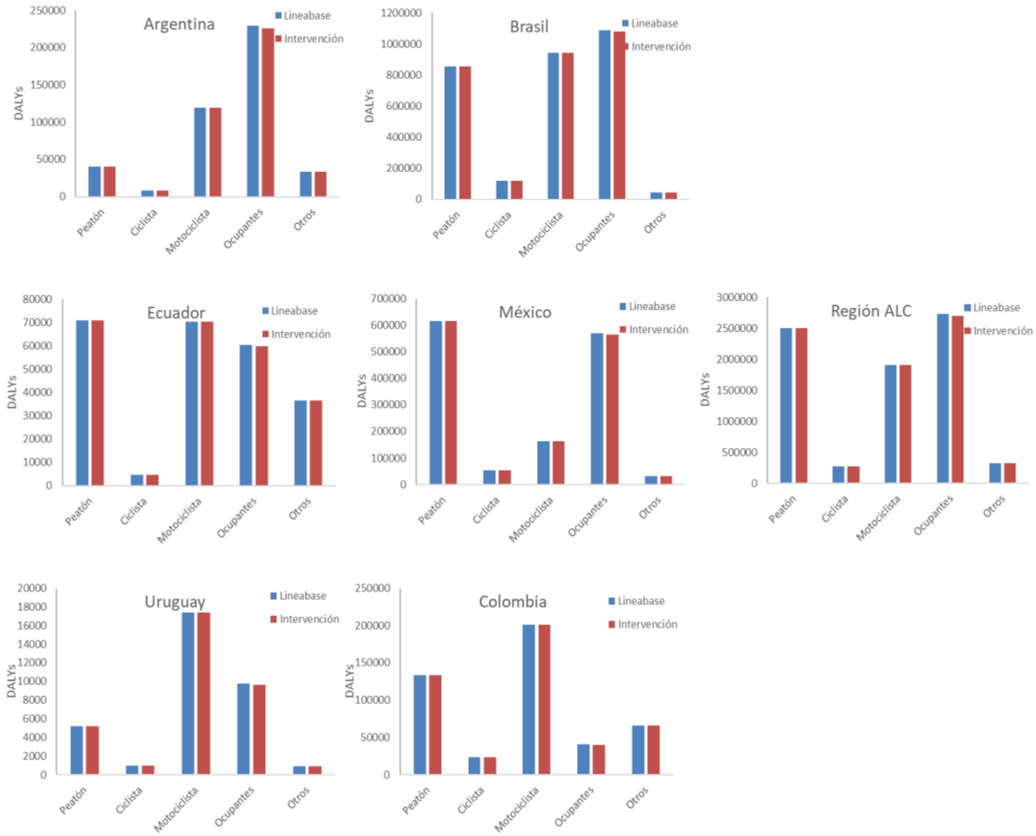


Figure *41* and **Table 23**) when health loss (measured in Disability Adjusted Life Years, DALYs) is compared because morbidity (years lived with disability) has a relatively lower impact on DALYs from road traffic crash injuries. The main estimate shows a reduction in lost DALYs of 0.7% in Argentina and only 0.1% in Colombia. The region as a whole would have 0.4% less DALYs, with a range of 0.2% to 0.5% based on the sensitivity analysis.

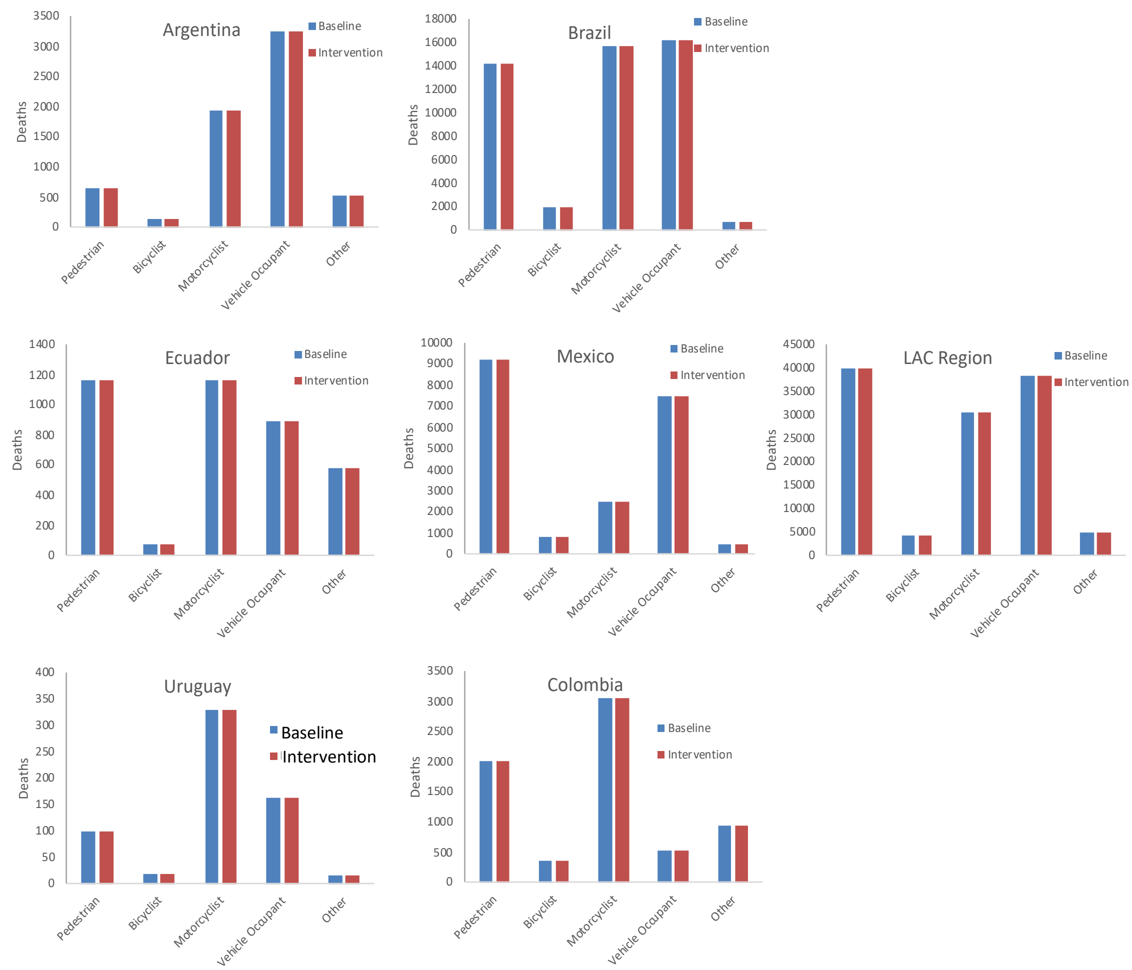


Figure 39. Relative risk and 95% confidence interval of injury associated with head restraints

Table 21. Estimates of lives saved annually in selected countries and the Latin America and Caribbean Region due to the increased use of head restraints

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	0	(0-0)	0.0%	(0.0%-0.0%)
Brazil	0	(0-0)	0.0%	(0.0%-0.0%)
Colombia	0	(0-0)	0.0%	(0.0%-0.0%)
Ecuador	0	(0-0)	0.0%	(0.0%-0.0%)
Mexico	0	(0-0)	0.0%	(0.0%-0.0%)
Uruguay	0	(0-0)	0.0%	(0.0%-0.0%)
LAC Region	0	(0-0)	0.0%	(0.0%-0.0%)

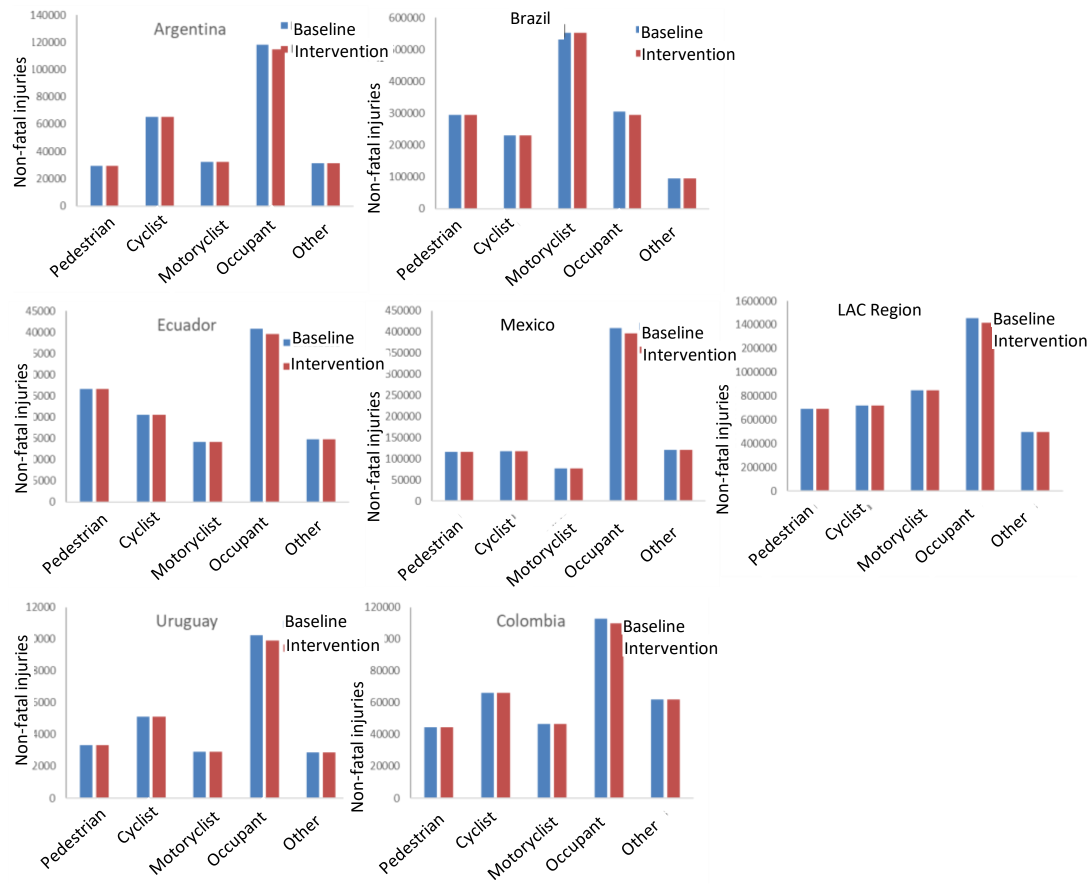


Figure 40. Estimates of the impact on annual non-fatal injuries in selected countries and in the Latin American and Caribbean Region by increasing the use of head restraints

Table 22. Estimates of annual non-fatal injuries averted in countries selected and in the Latin American and Caribbean Region by increasing the use of head restraints

	Calculations		% Current Injuries	
Lives saved	Main	Rank	Main	Rank
Argentina	4363	(2465-5922)	1.6%	(0.9%-2.2%)
Brazil	15259	(9025-20712)	1.1%	(0.6%-1.5%)
Colombia	797	(380-1082)	0.2%	(0.1%-0.3%)
Ecuador	839	(474-1139)	0.7%	(0.4%-1.0%)
Mexico	9677	(5468-13135)	1.2%	(0.7%-1.6%)
Uruguay	200	(123-271)	0.8%	(0.5%-1.1%)
LAC Region	42988	(24290-58349)	1. 0%	(0.6%-1.4%)

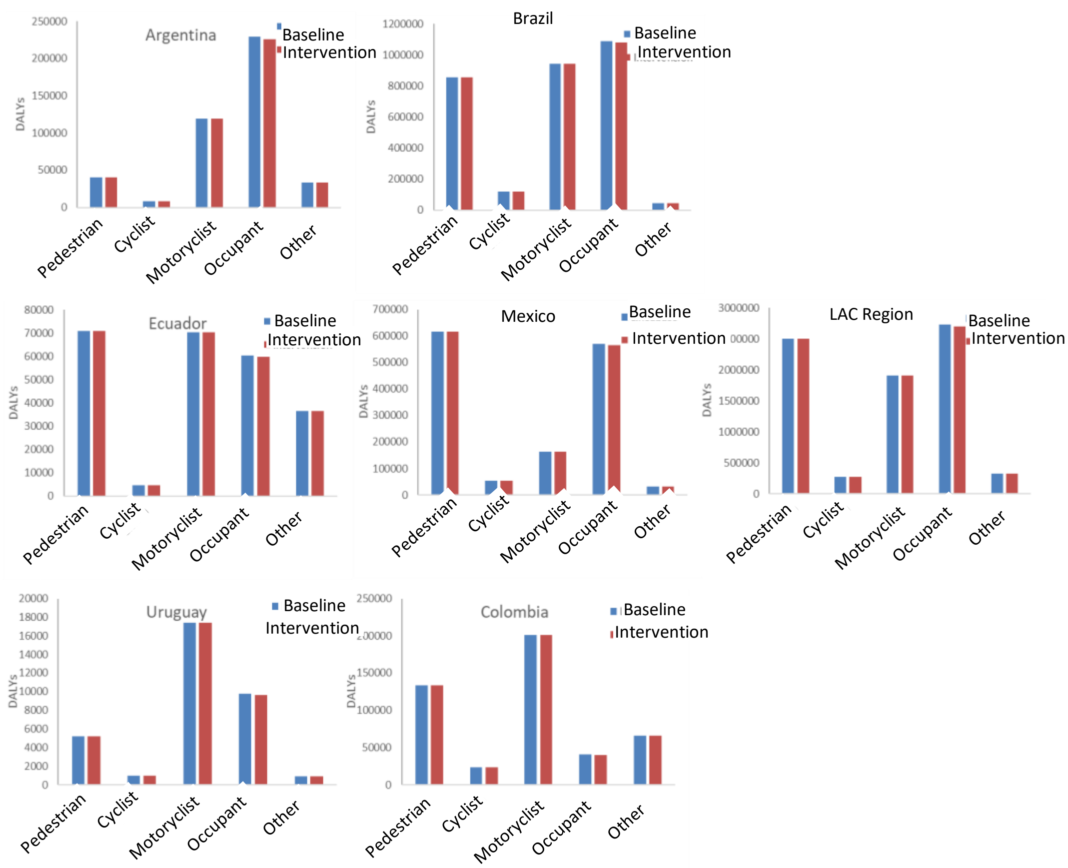


Figure 41. Estimates of the impact on health loss (measured in DALYs) in selected countries and in the LAC region by increasing the use of head restraints

Table 23. Estimates of annual health loss (measured in DALYs) averted in selected countries and in the LAC Region due to the increased use of head restraints

Lives saved	Calculations Main	Rank	% Current DALYs Main	Rank
Argentina	2826	(1597-3836)	0.7%	(0.4%-0.9%)
Brazil	10771	(6370-14620)	0.4%	(0.2%-0.5%)
Colombia	537	(256-729)	0.1%	(0.1%-0.2%)
Ecuador	585	(331-795)	0.2%	(0.1%-0.3%)
Mexico	6880	(3887-9338)	0.5%	(0.3%-0.7%)
Uruguay	114	(70-154)	0.3%	(0.2%-0.5%)
LAC Region	30137	(17029-40907)	0.4%	(0.2%-0.5%)

II-4.10 Vehicle front design for pedestrian protection

Background information

Car crashworthiness design can have a substantial impact in reducing the injuries sustained by pedestrians. The structures that interact with pedestrians (bumper, hood, windshield and A-pillar) can be made softer without compromising the structural integrity of the vehicle. Such modifications are now fairly common in the European Union where UN regulations require car manufacturers to incorporate pedestrian safety designs and consumer organizations like the European New Car Assessment Program (Euro NCAP) test the pedestrian safety performance of cars. Regulations and NCAP programs in the USA do not yet incorporate pedestrian safety testing.

Evidence from Germany suggests that improvements in car design due to regulations and competition resulting from NCAP testing have been effective in reducing pedestrian injuries in real-world crashes (Pastor 2013; Strandroth et al. 2014). In Germany, no cars received a 3-star rating in 1997, but by 2013, after the introduction of NCAP testing and regulations on pedestrian protection, 97% of cars received at least a 3-star rating. Statistically significant reductions of 20-56% were found for injuries to pedestrians. Probabilities of death and injury for a pedestrian hit by a car were obtained for each star rating (Pastor 2013; Strandroth et al. 2014) and the reduction in pedestrian injuries in the LAC region was estimated if all cars and light trucks scored at least 3 stars in the Euro NCAP pedestrian protection tests. It is assumed that, at baseline, all vehicles in the region would perform at 0-star level in Euro NCAP pedestrian ratings. It is important to note that the analysis is limited to cars and light trucks, which are the only vehicles that are subject to the regulations and NCAP ratings.

Estimates

Figure 42 and **Table 24** show the expected impact of improving all vehicles to at least 3 stars in pedestrian protection on annual fatalities in selected countries and in the LAC region. To be conservative, the benefits were only applied to pedestrian fatalities, although indirect benefits for bicyclists and possibly motorcyclists are likely. The main estimates show a decrease of 18% in pedestrian fatalities in the LAC region. The largest reductions in pedestrian fatalities are estimated for Ecuador (19.2%), and the lowest for Colombia (11.5%), where the proportion of pedestrians killed by car crashes is lower than in the other countries.

The total number of lives saved annually due to improvements in vehicle front-end design ranges from 8.1% in Mexico to 1.7% in Argentina, where pedestrian fatalities are the lowest proportion. In the region as a whole, fatalities would decrease by 6.0% (7,078 deaths), with a range of 3.7% to 6.2% according to the sensitivity analysis.

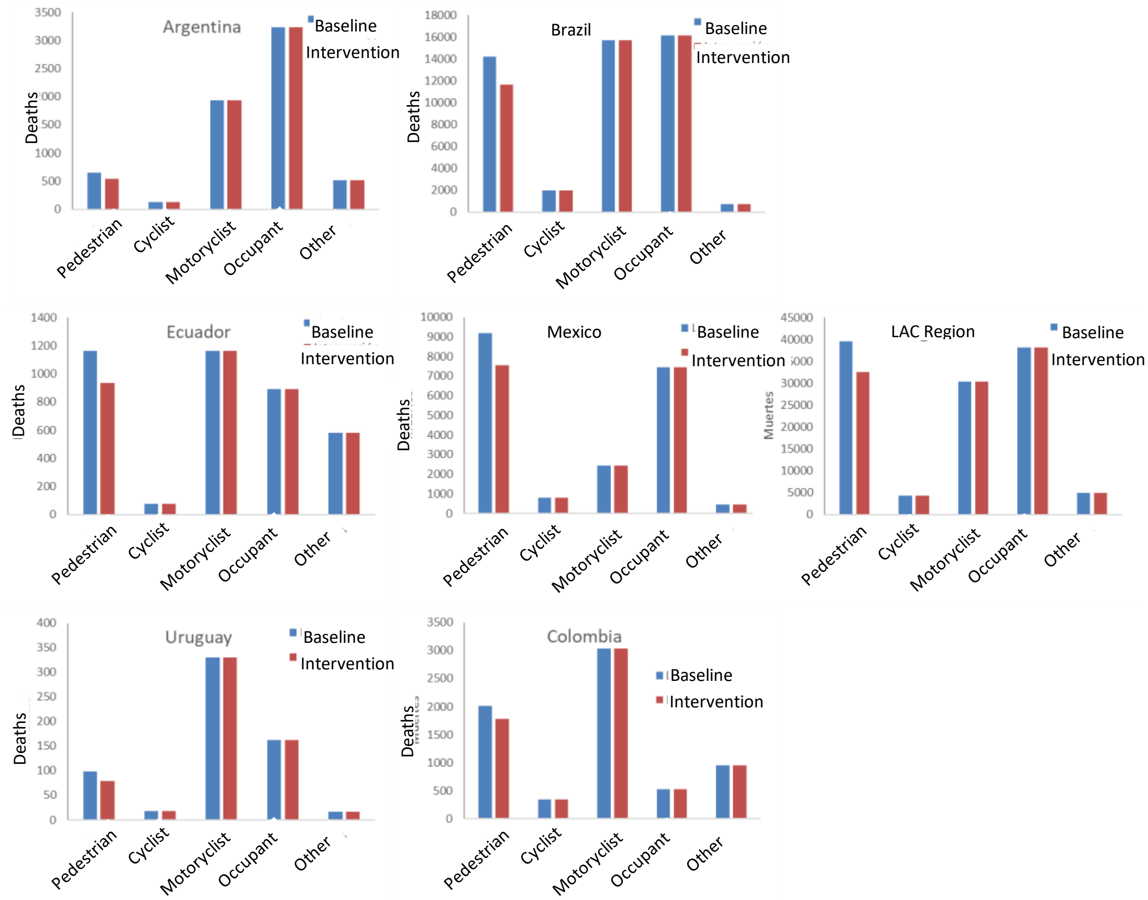


Figure 42. Estimates of the impact on annual deaths in selected countries and in the Latin American and Caribbean Region by improving vehicle front design for pedestrian

Table 24. Estimates of Lives Saved Annually in Selected Countries and the Latin America and Caribbean Region due to the Improvement of Vehicle Front Design for Pedestrian Protection

	Calculations		% Current deaths	
Lives saved	**Main**	**Rank**	**Main**	**Rank**
Argentina	111	(71-119)	1.7%	(1.1%-1.8%)
Brazil	2531	(1560-2621)	5.2%	(3.2%-5.4%)
Colombia	232	(221-372)	3.4%	(3.2%-5.4%)
Ecuador	224	(128-215)	5.8%	(3.3%-5.5%)
Mexico	1641	(1011-1699)	8.1%	(5.0%-8.3%)
Uruguay	19	(11-18)	3.0%	(1.7%-2.9%)
LAC Region	7078	(4362-7328)	6.0%	(3.7%-6.2%)

II-4.11 Overall effect of vehicle design improvements

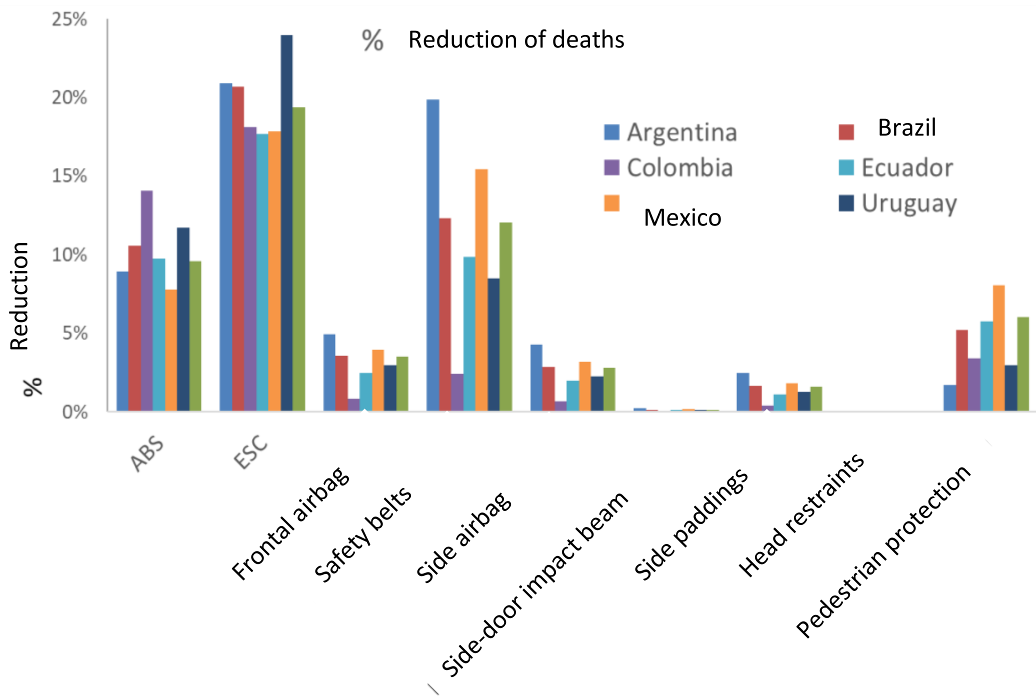
Background information

[**Reduction** of deaths (%)

Argentina, Colombia, Mexico, Brazil, Ecuador, Uruguay
ABS, ESC, Frontal airbag, Safety belt, Side airbag, Side-door impact beam, Side paddings, Head restraints, Pedestrian protection]

Figure *43* compares the impact of the different technologies evaluated. for the most significant improvements result from ESC and safety belt (use). An estimate of the combined impact of these technologies cannot be obtained by combining the individual estimates. Simply adding the lives saved by individual technologies will likely overestimate the benefits because it would lead to double counting of deaths that could have been averted by either technology. Therefore, overall gains are estimated by estimating lives saved separately for different road user groups as follows:

- **Occupants:** For occupants, Kahane's (2015) estimates of the annual reduction in occupant mortality risk in the USA due to vehicle design improvement between 1960 and 2012 were used (see **Figure 19**). For the main estimate, the current fleet in the LAC region was assigned to have safety characteristics similar to the USA in 1990. For the sensitivity analysis, the year was modified to 1980 and 2000.
- **Pedestrians**: To estimate pedestrian fatalities, the pedestrian protection model was used. It should be noted that these are conservative estimates of overall impact because the role of other technologies that may reduce pedestrian injuries (such as ABS) were ignored).
- **Motorcyclists:** The motorcycle ABS model was used to estimate motorcycle fatalities.



[Reduction of deaths (%)
Argentina, Colombia, Mexico, Brazil, Ecuador, Uruguay
ABS, ESC, Frontal airbag, Safety belt, Side airbag, Side-door impact beam, Side paddings, Head restraints, Pedestrian protection]

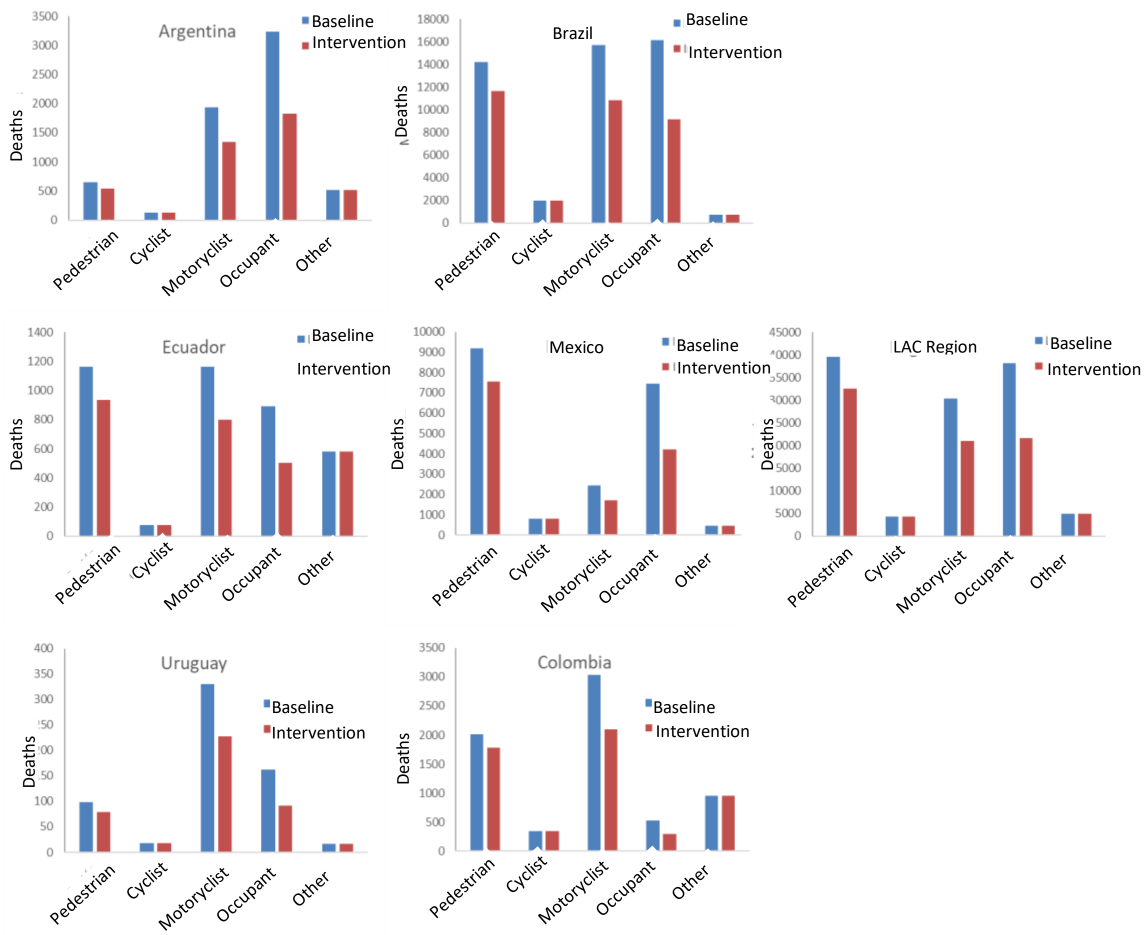
Figure 43. Comparison of the impact of various technologies on total traffic crash fatalities in selected countries and the LAC Region

Estimates

[Argentina / Brazil / Ecuador / Mexico / LAC Region / Uruguay / Colombia

Baseline / Intervention
Deaths
Pedestrian/Bicyclist/Motorcyclist/Vehicle Occupant/Other]

Figure *44* and **Table 25** show the expected impact of general automotive improvements on road traffic fatalities in selected countries and in the LAC region. The overall benefits are substantial. The main estimates show reductions in total road traffic fatalities ranging from 20.4% in Colombia to 32.7% in Argentina. For the region as a whole, road traffic fatalities would decrease by 28.1% (33,052 deaths per year), ranging from 22.8% to 28.3% according to the sensitivity analysis.



[Argentina / Brazil / Ecuador / Mexico / LAC Region / Uruguay / Colombia
Baseline / Intervention
Deaths
Pedestrian/Bicyclist/Motorcyclist/Vehicle Occupant/Other]

Figure 44. Estimates of the overall impact of improving vehicle design in selected countries and the LAC Region

Table 25. Estimates of lives saved annually in selected countries and the LAC Region from overall improvements in vehicle design

	Calculations		% Current deaths	
Lives saved	Main	Rank	Main	Rank
Argentina	2111	(1550-2301)	32.7%	(24.0%-35.6%)
Brazil	14385	(11713-14620)	29.5%	(24.0%-30.0%)
Colombia	1401	(1463-1437)	20.4%	(21.3%-20.9%)
Ecuador	969	(811-942)	25.0%	(20.9%-24.3%)
Mexico	5627	(4429-5569)	27.6%	(21.8%-27.4%)
Uruguay	191	(162-195)	30.6%	(26.1%-31.3%)
LAC region	33052	(26809-33227)	28.1%	(22.8%-28.3%)

CHAPTER II-5. Analysis

Road traffic crashes are one of the leading causes of death and disability in the Latin American and Caribbean region, especially among young adults. While LAC has made significant progress in fighting infectious diseases, it has failed to reduce injuries or deaths caused by road traffic crashes. Therefore, there is an urgent need to implement effective interventions that reduce the risk of crashes that cause these deaths and injuries.

There is considerable evidence that vehicle design technologies have had a large impact on reducing road traffic deaths and injuries in countries with mature economies. This study reviewed the scientific literature and identified technologies that have improved health outcomes in real-world crashes. This analysis aimed to answer the question: "What would happen if similar technologies and improvements in vehicle design were available in countries in the LAC region?" A conservative approach was taken, excluding emerging technologies that are very promising (such as automatic emergency braking and lane departure warning), but whose performance in real-world crashes is still unknown.

The results show that there are several technologies that can have a significant impact on reducing road traffic injuries. In particular:

Increasing the availability of ESC would have the greatest benefits in terms of lives saved and disability averted for occupants, pedestrians and motorcyclists. Many of these benefits derive from ABS technology, which is included in ESC. In particular, ABS for motorcycles is one of the few vehicle technologies that can have a significant impact in reducing injuries in countries such as Colombia, where motorcyclists account for a large proportion of deaths and injuries.

Increased use of occupant protection technologies, including safety belts, frontal and side airbags, side structure and padding, would have a significant impact on road traffic deaths in countries where occupants account for a large proportion of deaths and injuries, such as Argentina.

Safety belts are a highly effective technology that is already present in most cars in the region, but their use remains low. The region needs to strengthen enforcement of safety belt laws to benefit from this technology.

Pedestrians in the region can benefit substantially from the advances in front end vehicle design.

This analysis assumes that the benefits of these technologies in the region would be similar to those gained in countries with mature economies where the performance of each technology was evaluated in certain collision configurations. However, it is important to note that obtaining the full benefits of the technologies often requires supportive structural design. Therefore, simply adopting a particular technology is not sufficient to gain similar benifit. For example, the effectiveness of an airbag in preventing injuries depends on whether or not safety belts are used. Airbags and safety belts are also more effective when the design of frontal and side crashworthiness, energy absorption and deformation of the vehicle structure ensures that the passenger compartment does not break apart. Therefore, while this analysis focuses on evaluating the impact of each technology, the purpose of the analysis is not to promote particular technologies. Instead, this analysis shows that vehicle manufacturers in countries with mature economies have successfully used various vehicle technologies in concert to achieve major improvements in vehicle safety, and that the Latin American and Caribbean region would benefit substantially from similar vehicle safety improvements.

This raises an important question: What motivated car manufacturers to improve vehicle safety in countries with mature economies? As shown in Chapter 1 of this section, there are two key mechanisms that have driven the evolution of vehicle safety performance in countries with mature economies. First, regulations were adopted requiring all cars sold to meet a minimum threshold of safety performance. Second, countries with mature economies established New Car Assessment programs that tested vehicles under conditions that were stricter than the regulations required and changed more frequently than the regulations themselves.

NCAP program safety ratings have a strong influence on consumer choice and create strong market forces for manufacturers to improve safety design. In fact, there is strong evidence from the USA that car manufacturers are responding to changing NCAP testing requirements by redesigning vehicles to be safer. Typically, this means improving the performance of individual technologies and optimizing the way these technologies work together to provide the maximum benefit. In the USA, these market forces have led to substantial improvements in real-world crash performance across the entire vehicle fleet. Therefore, while regulations that create a minimum safety threshold are important, much more can be achieved through mechanisms that incentivize manufacturers to do better.

In summary, improvements in vehicle design can substantially reduce the risk of death and injury in road traffic crashes in the LAC region. Countries in the region need to adopt design standards, such as the United Nations Regulations annexed to the 1958 Agreement that have been developed by the World Forum for Harmonization of Vehicle Regulations, so that cars meet a basic safety threshold. In addition, there is a need to create market mechanisms, for example through NCAP's star rating programs, to encourage manufacturers to develop the safest possible designs.

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PART III.

POTENTIAL ECONOMIC IMPACT ON REGIONAL COUNTRIES FROM IMPROVING VEHICLE SAFETY TECHNOLOGIES

Presentation of Part III

This third section of this study analyzes the trade and fiscal gains in LAC countries as a result of the possible adoption of the selected UN regulations. A general equilibrium model is applied, which takes into account the relationship between all the markets of interest, their links and Interrelations.

CHAPTER III-1. Introduction

The objective of this section is to assess the economic impact on the LAC region if LAC countries adopted the UN vehicle safety regulations recommended in this study.

The economic consequences of the lack of road safety cause losses for all areas of society. As a consequence of a road traffic crash that could have been averted, households may lose their economic sustenance organizations may lose employees whose positions are not always easily replaced and the government and businesses may have to replace or repair damaged infrastructure. These losses take on an even more troubling dimension considering that according to data from the World Health Organization (WHO), a person is killed or seriously injured in a traffic crash around the world every 25 seconds.

This high global frequency of car crashes is not uniform across countries. The institutional and economic characteristics of countries generate different crash and mortality rates. In particular, taking income as representative of differences between countries, the Institute for Health Metrics and Evaluation (IHME) has concluded that 93% of road traffic-related deaths occur in low- and middle-income countries, which have 48% of the world's vehicles. One of the regions that is suffering the most from road crashes is Latin America, where crashes are already among the top seven causes of death (World Health Organization, 2018).

These negative consequences create countless problems for families, governments, and society in general. According to data provided by the WHO, if rapid action is not taken to improve road safety, the number of road traffic fatalities is expected to increase by 80% in low- and middle-income countries in the next two years. Luckily, experts already know how to reduce road traffic deaths and injuries. Experts say: "Road safety is no accident”.

In order to study the potential economic impact of the UN Regulations recommended in this report, the group of countries participating in the Regional Public Good project were selected. This group includes countries with developing automotive industrial sectors. Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay were therefore taken as study references.

In order to carry out an economic assessment, it is necessary to adopt an economic reference framework that responds to the concerns of the report. The WHO (World Health Organization 2009) has done a great job systematizing the different approaches used to measure the economic impact of diseases and road crashes in general. The methods used can be grouped into four areas: i) consequences in terms of the years of life lost by individuals; ii) consequences in terms of the direct and indirect costs for the health system; iii) consequences expressed in terms of the loss of well-being; and iv) consequences measured in terms of the net changes in people's income.

These methods can be used to measure impacts on a group of agents or to measure systemic impact that influence the entire economy. Depending on the objective of the economic policy, different emphasis is placed on the methods and unit of work to be used. Thus, thanks to the work of microeconomic analyses, it is known that road traffic injury-impacted households suffer great economic losses, which can sometimes lead to poverty for the entire family unit. Similarly, these analyses show that the economy is neglecting opportunities for economic growth as a result of poor road safety.

As captured in the literature analysis in the index to this report, most of the work that analyzes the economic impact of vehicle crashes use literature that measured the economic consequences of noncommunicable diseases as a conceptual framework for their analysis. Although this is a very rich conceptual framework, it is also necessary to add the issue of road safety, since it is vital to the economic analysis

On the one hand, one of the most salient characteristics of road collisions is that they impact young people more intensely. According to IHME statistics, the largest generation of Disability-adjusted Life Years (DALYs) generated by road crashes in the world is in the age range of 20-64 years. This age group is in the middle of their productive years and starting families and careers.

On the other hand, since it is necessary to include the added costs it takes improve road safety, it is vital to consider the impact on the automotive production and marketing sector. The participation of the automotive sector in Latin American economies is diverse and depends on the production structures in place. As explained later in this report, for 2016 and 2017 the automotive industry represented between 0.3% and 4% of the Gross Domestic Product of studied countries.

This part of the study is divided into three chapters in addition to this introduction. The following chapter presents the method used to conduct the economic assessment without describing the technical aspects of the methodology that are relegated to the appendices. The following chapter reveals the results that arise from calibrating the information available with the models presented. Finally, the last chapter discusses the results obtained.

CHAPTER III-2. Impacts on the economy from the implementation of UN Regulations

The human suffering caused by road collisions is colossal: for every crash victim, there are family members, friends and communities who must deal with the physical, psychological and economic consequences of the death, injury or disability of a loved one.

Sometimes, the cost of healthcare, the loss of the primary wage earner, funeral expenses, or loss of income due to a disability can even drive families into poverty.

Here is a fictional example to provide insight into such a loss. Let's say that a member of a household was involved in a road crash and unfortunately died. This event triggers a chain of events with important economic consequences. Here, we include an incomplete list for the purpose of enumerating the most important consequences.

First of all, the household has to incur the costs associated with the healthcare for the injured person, and burial costs generated by the ultimate death. Households are forced to use whatever money they have to cover these costs instead of allocating them to alternative expenses.Obviously the health care sector receives income as a result of these expenditures.Second, after the crash, if the vehicle has to be repaired, the repair and maintenance sector will receive income as a result of the work to fix the damage.In some cases the vehicle may have been completely destroyed and can not be repaired.

A road collision also creates financial consequences for insurance companies. When an crash occurs, these companies must cover the repair costs, if there are any.

Note that these events generate changes in household spending habits. t. If the person injured or killed is a worker, there is also another sequence of impacts resulting from their exit from the labor force.

As a result of the unpredictability inherent in a car crash, there is a negative impact on the person's social and labor network. A series of commitments that the person could have adopted are broken, negatively impacting the productivity of the organization to which he or she belonged.

It must be considered that the chain of negative events for a household described above is repeated many times during a day in each of the countries involved in this study, with different specific circumstances.It is easy to intuit that the negative effects on the economy accumulate rapidly and are substantial. According to data reported by the IHME for 2016, this chain of events takes place every 82 minutes in Argentina, every 11 minutes in Brazil, every 76 minutes in Colombia, every 135 minutes in Ecuador, every 26 minutes in Mexico and every 14 hours in Uruguay.

It is impossible to collect all possible sequences of events triggered by an crash. Therefore, in order to make analysis feasible, thousands of possible stories will be simplified into their most common elements with a focus on those with the greatest economic impact.

When vehicles become safer as a result of the implementation of the recommended regulations, these chains of economic and social loss never occur. If the crashes no longer occur, households no longer have to incur the associated costs. The analysis must therefore include the economic impact of regular spending conducted by families who are now longer negatively impacted by an road crash and continue in their normal consumption patterns.

To comprehend the analysis in this chapter, it is essential to understand that once the regulations recommended in this report are implemented, due to the decrease in the number of road crashes, many households will no longer have to go through the chain of events described above. This exercise of imagining an alternative reality is called a counterfactual analysis.

In the counterfactual analysis carried out in this report, households that no longer experience road crashes use their disposable income for three alternative purposes: i) consumption that is not associated with health; ii) increase in human capital through formal education and training of the household members; and iii) increase in the capital stock of the economy.

Following the recommendation presented previously, the measuring exercise will focus on what are understood to be the most important elements to be analyzed, taking into account the recommendations made by the World Health Organization and reported in the report (World Health Organization, 2009).

of the most important factor for analysis is the economic impact of the reduction in deaths generated by the changes in the regulations in relation to the current safety status of the vehicle fleet. Subsequently, the impacts of the redistribution of expenses made by the members of the households are determined. This redistribution of expenses, together with the reduction of deaths, has impacts on supply and therefore generates changes in supply. Likewise, if vehicle regulations are the same in Latin America, the Caribbean and outside the region, changes also take place in trade. Finally, all these impacts are combined together in a General Equilibrium model, from which the final results are obtained in terms of changes in the countries' Gross Domestic Product.

The method used to carry out the impact assessment in this study is described synthetically in the sequence represented in **Figure *45***.

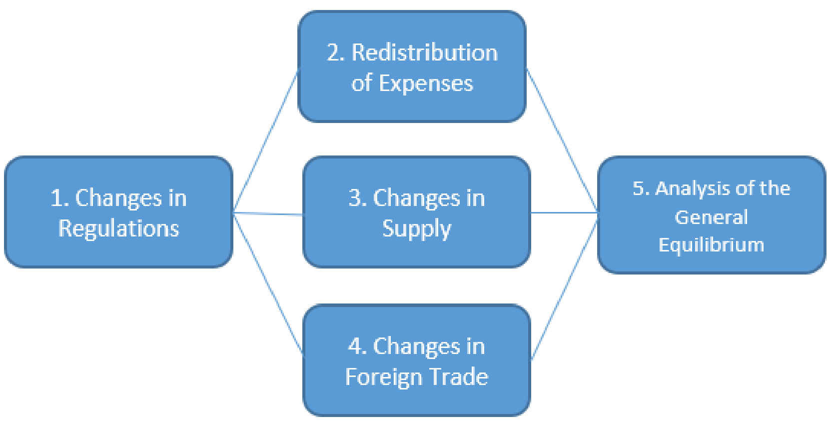

Figure 45. Steps to carry out the assessment

The following sections describe each of the steps, leaving the formal details for the annexes of this part of the study.

III-2.1 Changes in regulations

The regulations assessed from an economic point of view in this study improve vehicle safety.

In order to understand this impact, it is necessary to evaluate the current state in connection with the technological conditions produced by current regulations. After establishing the impact of current regulations, it is possible to make predictions about the impact of proposed regulatory changes.

The analysis of changes in the regulations was presented in the second section of this report, and the economic impact assessment is based on these results.

In the second section of this study, the work carried out by a team of the University of Chicago team analyzed the impacts of introducing the vehicle safety technology suggested in this study.

Table *26* summarizes the results of the second part of the study in terms of reduction in road crash fatalities. While the authors distinguish deaths by types of users: pedestrians, cyclists, motorcyclists, vehicle occupants and other types of deaths, the table presents the aggregate result.

Table 26. Estimated changes in the number of deaths due to the introduction of vehicle safety technology

Country	Current deaths due to road crashes	Deaths potentially saved by new regulation	% Deaths potentially saved compared to current numbers
Argentina	6,463	2,111	33%
Brazil	48,724	14,385	30%
Colombia	6,863	1,401	20%
Ecuador	3,871	969	25%
Mexico	20,351	5,627	28%
Uruguay	623	191	31%

Source: Work contained in the previous chapter of this study

The second column presents the actual number of deaths, considering the safety technology available in the entire vehicle fleet of each country at present. The third column presents the expected number of deaths that could be prevented if safety technologies were implemented in vehicles in compliance with the suggested UN regulations. The fourth column presents the reduction of deaths in relative terms. Note that approximately 20% to 30% of deaths would be averted in these countries as a result of changing vehicle technology to meet the recommended regulations.

The data on the number of deaths averted also provides information on the number of people who suffered road crashes but did not die. The estimates of the Global Burden of Disease have been used to obtain the relationship between deaths and non-fatal crashes.

III-2.2 Redistribution of expenses

As a consequence of having a lower number of crashes, households would save money which could be used for different purposes, other than health costs and vehicle repairs. Therefore, it is necessary to specify how households redistribute these expenses.

In this phase, households are expected to stop spending on health and start spending on goods or assets that are not health related. They will invest in education and generate savings that are invested in capital to anticipate their increased life expectancy.

On the one hand, it should be noted that people will not have to put money aside for health costs anymore. These savings will be used for another purpose as explained below.

To estimate the expenditures a household will longer devote to health, the costs incurred by an crash are taken out. In order to do this and to be able to make comparisons among all countries, these costs are withdrawn from all the different activities involved in the death of an individual or in his or her recovery when an road crash is not fatal.

Table *27* lists the most important household costs in case of a crash. Note that when a person does not die, but must undergo some form of treatment to improve his or her health, the cost associated with the funeral is not incurred. Since information was not available for all countries, information was taken from the works of Bocarejo, Velasquez, Diaz and Rojas (2011), Bhalla, Diez-Roux, Taddia, De la Peña, Sissi and Pereyra (2013), CONACET (2017), Karaisi and Domínguez (2011), Perez and Carachi (2012) along with consultations with the public health systems of all countries to standardize and obtain the approximations expressed in the table.

Table 27. Expenditure as % of GDP per capita in countries

Activity	Expenditure as % of GDP per capita
Use of ambulance	0.4%
Admission to hospital	0.6%
Intensive care	5.7%
Funeral	7.4%
Damage of property	40.0%
Administrative costs	3.3%

The percentages above are estimates based on incomplete information for each country. To make the findings more robust, variations on these parameters will be explored.

Thus, using this information combined with that obtained in the previous section, it is possible to estimate the direct expenditure saved by households.

III-2.3 Changes in supply

The introduction of new regulations would improve people's health because it would reduce injuries and fatalities. Likewise, as shown in the literature review in the appendix, improvements in population health have a positive impact on various aspects of the economy, and one of them is positive changes in supply.

Using the framework presented by Howitt (2005), it is possible to group the effects into three mechanisms that will be modeled: i) increase in the productivity of individuals; ii) increase in labor supply; and iii) increase in the capital of the economy. The following paragraphs will explain these effects in more detail.

First, improvements in the productivity of individuals have multiple sources. It is reasonable to expect that an individual who is in better health will generate better and more results per hour worked. On the one hand, productivity could be maximized directly through increased physical and mental activity. On the other hand, more physically and mentally active individuals could make better and more efficient use of the technology, machinery and/or equipment they use in their productive labor.

A healthy workforce is likely to be more flexible and therefore better prepared to adapt to change. This labor flexibility can translate into a reduction in job rotation, since the same worker can adapt to more tasks. Reduced job rotation means lower labor costs, translating to higher productivity. One of the benefits of good health is that it tends to make a person more creative and, by extension all these effects improve productivity.

Education also improves with good health. Human capital theory suggests that more educated individuals are more productive and earn more.

This effect is observed easily in children. Children with better health and nutrition achieve better educational results, suffer less absenteeism and do not leave school early. If an individual's good health is linked to a longer life, healthier people would have more incentive to invest in education and training, since the rate of depreciation of skill gains would be lower.

Health plays an important role in determining the rate of return on education. People in good health are focused and alert. This makes their learning abilities greater and it therefore has a positive impact on productivity.

In addition, the increase in labor supply is associated with the fact that, as the number of injuries and fatalities decreases, there are more workers contributing working hours. In this sense, the analysis model assumes that the accumulation of labor services leads to economic growth (Lopez-Casanova, Rivera and Currais (2005)).

Finally, the third reason good health affects supply is capital increase. Households with better health are concerned about increasing their savings. The good or bad health of an individual or a population impacts not only the level of income, but also the distribution of income between consumption, savings and investment. Healthy people have a longer life horizon, so their savings rate is higher than that of unhealthy people. Therefore, a population that experiences a rapid increase in life expectancy - all other life aspects remaining the same - can be expected to have higher savings. These higher savings translate into increased investments, which lead to more capital for the economy.

Howitt (2005) also highlights the effect of good health on income distribution. Empirically, there is a strong negative correlation between the various health indicators of the population and income inequality measures [see Deaton (2003)]. While the causal interpretation of this correlation remains an open question, many measures that improve health result in less inequality, since their main impact is on the less privileged members of society. A reduction in income inequality is likely to have a positive effect on economic growth.

III-2.4 Changes in foreign trade

The foreign trade of automotives in Latin America should be analyzed in terms of the sectoral characteristics of the region, the macroeconomic characteristics of the countries that make up the region, and the general hypothesis adopted in this evaluation that all countries in the region simultaneously adopt and require that vehicles, their parts and their components meet the standards of UN regulations proposed in this study.

First of all, it is important to consider the transformations that have taken place since the 1990s within industrial production systems, which has their fundamental origin in the automotive sector. These changes go hand in hand with two other important transitions: the development of globalized value chains, and the expansion of lean production[12]systems, which tend to locate production in specific regions in an attempt to reduce inventort. This framework is introduced in the context of increasing automation within production processes.

Second changes in the productive systems in Latin America have taken place along with the development of other changes. On the one hand, national administrations are trying to further develop local industries, which produced a network of regulations and bilateral agreements that aim to accompany these developments. This includes a battery of tariffs aimed at protecting the development of the automotive sector.

For example, the Argentine Automotive Industry Rules of 1991 developed a scheme of tariff reductions for imports of vehicles and auto parts. Among the protectionist measures covered by the rules, a maximum import content of 40% was required; a system of compensated exchange was made mandatory for firms; 25% of the value of exports by end companies had to come from products of independent auto parts companies; and a quota system was established for imports.

In 2000, the Mercosur Common Automobile Policy was signed by Brazil and Argentina to regulate bilateral trade. The agreement sought to encourage the continuity of investments in the automotive industry and to prevent Brazilian subsidies from distorting the flow of such investments. The agreement established a common external tariff of 35% for vehicle imports from third countries.

Automotive trade within the region would have a 100% tariff preference, i.e. no tariff. However, in order to access the preferential tariff, a trade compensation clause was established through a deviation coefficient called "flex". The flex coefficient is a quotient between imports and exports that compensates trade between both countries. This coefficient has been adjusted over time to adapt to the different needs of the various periods, ranging between 2.6 in 2005 and 1.95 in 2006, to 1.5 in 2014. In this manner, the mechanism establishes that for each dollar that one country exports to another, it can import up to 1.5 dollars from the automotive industry in that country.

Another relevant contextual factor for framing this analysis is the ongoing monetary and real instability that impacts the planning and programs of sustained productivity increases in the region. **Figure 46** summarizes the inflation history of the countries under consideration. In order to read the data more clearly and to make comparisons between countries, the data are presented by truncating the inflationary levels above 50%. As the graph shows, Macroeconomics offers a better context of relative stability only in the last ten years. However, in recent years average annual inflation has been above 4% for all countries, which shows the difficulty the region has had in providing a stable framework for the automotive industry.

This instability has been one of the most important limitations for the industrial sector to build a platform to improve productivity in order to compete abroad.

[12] The lean production method, transformed the mass production methods in the early 90's. The transformation is very carefully developed in Roos, Jones y Womack's work "*The Machine that Changed the World*" (1992).

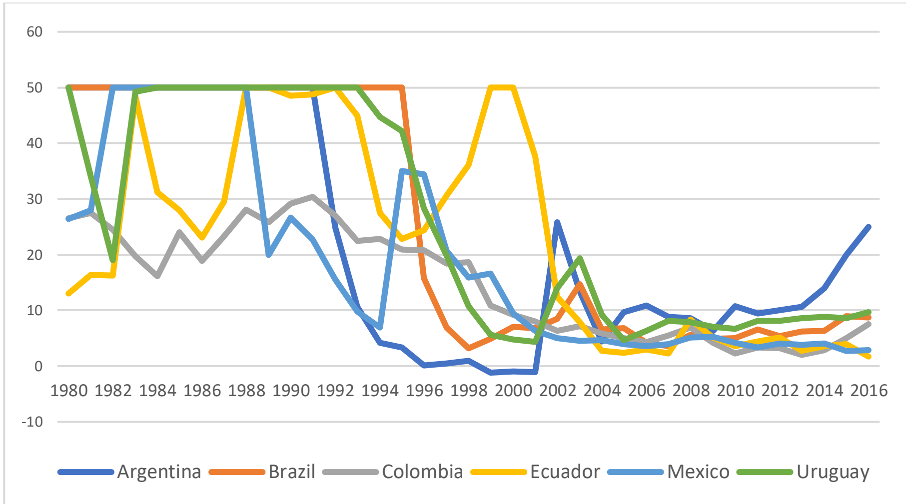

Figure 46. Inflation variation in LAC countries

Source: World Bank, own production

(*)The periods of inflation greater than 50% were limited to improve the visual representation of the data.

With this conceptual framework, it is possible to analyze the changes in foreign trade associated with the approval of the standards proposed in the project, referring to the effects that may occur in the Latin American region and outside the region. Those involved in trade are the assemblers and auto parts manufacturers.

To simplify the analysis, the effects generated on the extensive margin are organized in the four quadrants described in **Table *28***. Each quadrant indicates whether the volume of trade is expected to increase, decrease or remain the same in relation to the situation prior to the introduction of mandatory approvals.

Table 28. Summary of extensive trade volume effects

Trade	Assemblers	Auto parts manufacturers
Regional Trade	1: Increase	2: Increase
Extra-regional Trade	3: Neutral	4: Increase

Assemblers' Regional Trade: Increase

In the scenario where all economies adopt and require the proposed UN regulations, there would be a periphery of vehicle importing countries in Central and South America that should reduce the import of second-hand vehicles, or vehicles that do not meet regulations. In this way, it is expected that these countries will have to reorganize their import system. Imports could be partially allocated to the region's producing countries. This effect would generate an increase in exports from manufacturing countries to these new importing countries in the region.

Assemblers' Extra-regional Trade: Neutral

Regional foreign trade is shaped by the institutional characteristics of the region. In the case of Mercosur, trade is controlled by the common tariff, which represents a major barrier to entry, so the requirement for standardization should not generate any additional effect on the countries under study[13]. In the case of Mexico, extra-regional trade is framed by its Free Trade Agreement with the countries of the North. In that treaty, approval is not expected to generate a substantial change, since all the units exported by Mexico to the USA and Canada already meet the regulations proposed in this report.

This effect considers that the productive specialization that is taking place in the region, where Argentina is specializing in the production of pickup trucks and Brazil in the production of small and medium cars, as well as small and medium SUVs. The process is advancing independently of the approvals proposed in this study, therefore the net effect on trade remains neutral.

Auto Part Manufacturers' Regional Trade: Increase

As shown in Annex III.2: Bibliographic Review, international experience indicates that the consequences of standardizing the goods traded in a region generate productive specialization in the region, which translates into an increase in regional trade.

In Latin America, a series of trade agreements have been established and they maintain a percentage of local production that must be incorporated into vehicles. Given that this study does not foresee changes in the production shares established in trade agreements, changes in trade are not envisioned.

However, the volume of trade in the region is expected to grow in order to supply spare parts to the new units that assemblers have sold in the region.

Auto Part Manufacturers' Extra-regional Trade: Increase

As a result of regional approvals and the increase in production associated with a greater volume of regional trade, economies of specialization are expected to fare better. This expansion of markets makes it possible to fully exploit economies of scale in the production of differentiated goods and to stimulate the development of intra-industry trade among members of the plan. In this way, each country can specialize in particular designs of certain goods and obtain efficiency gains. Under conditions of increasing returns to scale, the trade integration plan could raise efficiency levels and move the productive system of the integrated zone to productivity levels similar to those of the most efficient producers in international terms.

The structural school of the Economic Commission for Latin America (ECLAC) has highlighted the need for industrialization for sustained growth. It stresses the need for technological innovation and the configuration of a national innovation system to achieve the development of dynamic comparative advantages. The idea is to develop strategic sectors, those with learning potential, which in the future will allow the expansion of exports to the central countries, going beyond the limits of South-South trade.

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[13] A new trade agreement between Mercosur and the European Union was announced during the final stage of the elaboration of this report. This agreement, which took 20 years to put into place, is still being developed and the rules for its implementation are still unknown. The results presented in this report consider that at least the adjustment period for the automotive sector will be approximately 10 years. This is the period in which the effects analyzed in this work can become visible. Given the uncertainty that prevails over the agreement, it is reasonable to maintain the assumption of neutrality in the assemblers' extra-regional trade.

Bekerman and Sirlin, (Bekerman and Sirlin, 1995) argue that economic integration boosts the development of greater efficiencies since it generates some protection against extra-regional supply. On the one hand, a larger market allows the formation of a more efficient process for locating resources in the region. This in turn makes it possible to exploit the advantages of economies of scale, increasing productivity and developing new fragments of the value chain within the region

At the same time, the incorporation of new techniques results in a dynamic learning development that generates positive externalities in the rest of the productive structure, improving the levels of competitiveness. In this context, the processes of specialization and productive complementation can be a key element in facilitating both the development of dynamic advantages and structural convergence among member countries in order to make the distribution of the benefits of integration more equitable. The pattern of bilateral specialization determines the comparative advantages that each country can consolidate through integration.

Multilateralism: more than a working hypothesis

This economic impact assessment addresses a theoretical situation in which the entire fleet M_1 (and N_1 derived from M_1), in each of the countries meets, at the same time, the safety standards corresponding to the subgroup of UN regulations defined at the beginning of the study. This is a methodological assumption aimed at isolating and measuring the effect of the proposed policy change.

Specifically for the analysis of the consequences on foreign trade, it is assumed that the rest of the countries in the region, even if they are not car producers, also adopt these regulations in a generalized manner. In other words, for this particular issue, a hypothesis of complete trade multilateralism is accepted throughout the region.

This is not an unrealistic assumption, but rather one that fits both with the history of the institutional evolution of the United Nations vehicle safety regulations, and with the same process expected for their adoption by the nations of Latin America and the Caribbean. In fact, the WP.29 Working Group was originally established to harmonize technical vehicle construction standards in Europe, eliminating technical barriers to reciprocal trade. And when it was generalized to all UN members, it became known as the "World Forum for Harmonization of Vehicle Regulations".

This multilateral framework was present from the beginning, through the leading role of the United Nations Economic Commission for Europe - UNECE (WP.29 is precisely a Working Group within it). Other UN agencies, such as the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic Commission for Latin America and the Caribbean (ECLAC), are also starting to contribute to the process of expanding this harmonization to the global level. The latter is now adding vehicle design aspects to its participation in this study, in addition to its longstanding regional leadership in the area of safer road infrastructure.

This dimension, corresponding to diplomacy and international negotiations, is decisive for the adoption of the common regulations proposed in this study. A non-producing country adopting more stringent safety regulations than producing countries in the region could entail a trade friction between parties that would increase the uncertainty of trade between economies.

The adoption of better environmental and safety standards for cars may face an initial disincentive if such a decision is taken unilaterally. The UN Regulations and their associated mechanisms of standardized type approval offer a system of mutual concessions and recognition, capable of ensuring the parties a balanced and flexible harmonization of the requirements to be imposed.

The simultaneous acceptance of the new rules at a regional level, i.e. the validity of a multilateral negotiation framework, seems to be a necessary condition to unlock their adoption. This is what the proposal of common regulations for the adoption of the UN regulations selected in this study proposes.

III-2.5 General Equilibrium Analysis

In an economy, all agents are interrelated, and decisions made by one agent impact what other agents do. In order to measure the net effect on household income, it is necessary to analyze all effects, or at least effects considered important, simultaneously and with a systemic or general system approach. In Economics, one of the techniques that allow for this combination of effects is called General Equilibrium.

A general equilibrium model takes into account the relationship between all interacting markets, their links and interrelations. When the price of a good or a factor changes, this will impact the market for the relevant good as well as related markets in terms of prices and quantities. Because of this, the overall effect can be measured by analyzing the interactions between markets.

For example, consider that increasing safety technology in vehicles reduces the overall number of deaths. As the number of deaths decreases, job supply increases. This increase in the job supply means real wages will go down. With lower real wages, companies can hire more, resulting in greater production.

This study also argues that as household expenditure spent on health is reduced, people will need less healthcare, which will lead to lower prices in the sector. This will have a negative effect on the economy as the number of people working in the health sector will drop.At the same time, households are now replacing health expenses with non-health goods and services. This increased demand for non-health goods raises spending, generating more employment in the corresponding sector.

Note that the first and third effects mentioned above improve the state of the economy, whereas the second effect has a negative consequence. The General Equilibrium technique helps to identify the net effect of these three forces. To understand the effect of the general interaction, the functioning of the most important markets and their interactions are modeled. Thus, the objective is to consider the economy in the broadest sense possible, emphasizing the most important processes, and addressing the interaction between all agents.

CHAPTER III-3. Analysis of the results

The results will be presented in three sections. The first section provides a brief analysis of the sectoral context in the region. The second section provides a brief description of the data use, and the third section presents the results and analysis of the most important potential variations on the base scenario.

III-3.1 Sectoral analysis

The economic consequences of vehicle crashes depend on the characteristics of the economy under study. Vehicle crashes in developed economies have a different effect than in developing economies. Developed economies have more road safety and social infrastructure resulting in a reduction in the number of collisions and their consequences.

Countries with improved road safety and social infrastructure are more advanced in the five pillars recommended by the global plan for the Decade of Action for Road Safety 2011-2020.

Clearly understanding the state of development of the five pillars in each of the six countries under consideration exceeds the objective of this study. However, it is reasonable to associate the development of these pillars with the level of gross domestic product (GDP) per capita of the countries under consideration.

Thus, **Figure 47** presents information on GDP per capita at purchasing power parity for the countries under study, associated with the number of people per light vehicle (with a capacity of 7 passengers).

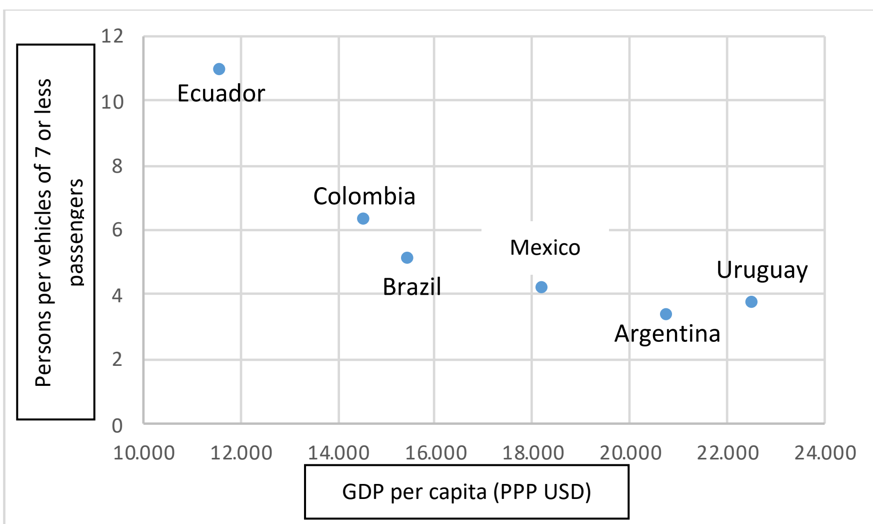


Figure 47. GDP per capita and vehicle occupancy rates for reference countries

(*)Data obtained from the World Bank, 2017

(**)Own production with data provided by AUTODATA for 2017

It is interesting to highlight two characteristics of this data. First, the number of people per vehicle decreases when the average income increases. This indicates that a vehicle is an asset acquired by families along with an increase in income. Second, it is interesting to note that the number of people per vehicle normalizes for countries that have a per capita income greater than USD 18,000.

Figure 48 shows the relationship between per capita income and the number of deaths due to road crashes. The horizontal axis represents the per capita income, the vertical axis represents the number of deaths per 100,000 inhabitants due to road crashes and the diameter of the circles represents the vehicle density per square kilometer.

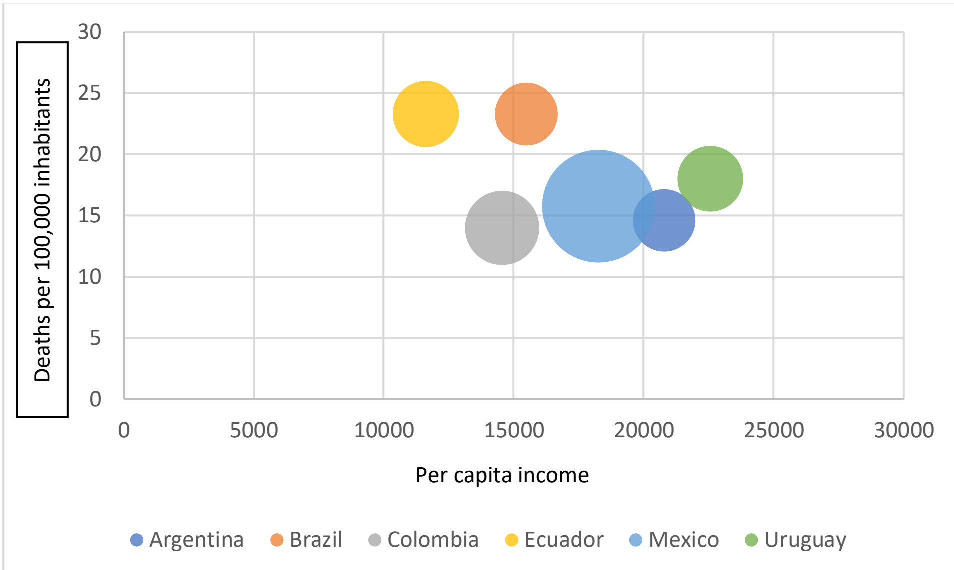


Figure 48. Income per capita and deaths due to road crashes

Source: Institute for Health Metrics and Evaluation and World Bank

When the per capita income is higher, the ratio of crashes due to vehicles is lower. Vehicle density per square kilometer does not seem to play an important role here. This means that factors associated with income indeed reduce the rate of death.

The evaluation of the economic impact of new safety technology on vehicles should also consider the impact on the vehicle manufacturing industry. This sectoris undergoing constant changes due to the rapid growth of the service sector. **Table *29*** presents the contribution of the automotive sector, which includes the auto parts industry, in the economies studied here.

Table 29. Contribution of the automotive sector in the economies (2016)

Country	% Manufacturing to GPD	% Automotive Sector to GPD	% Automotive Sector to Manufacturing
Argentina	14%	1.6%	11%
Brazil	11%	2.1%	19%
Colombia	13%	0.7%	5%
Ecuador	18%	0.6%	3%
Mexico	17%	4.4%	26%
Uruguay	13%	0.5%	4%

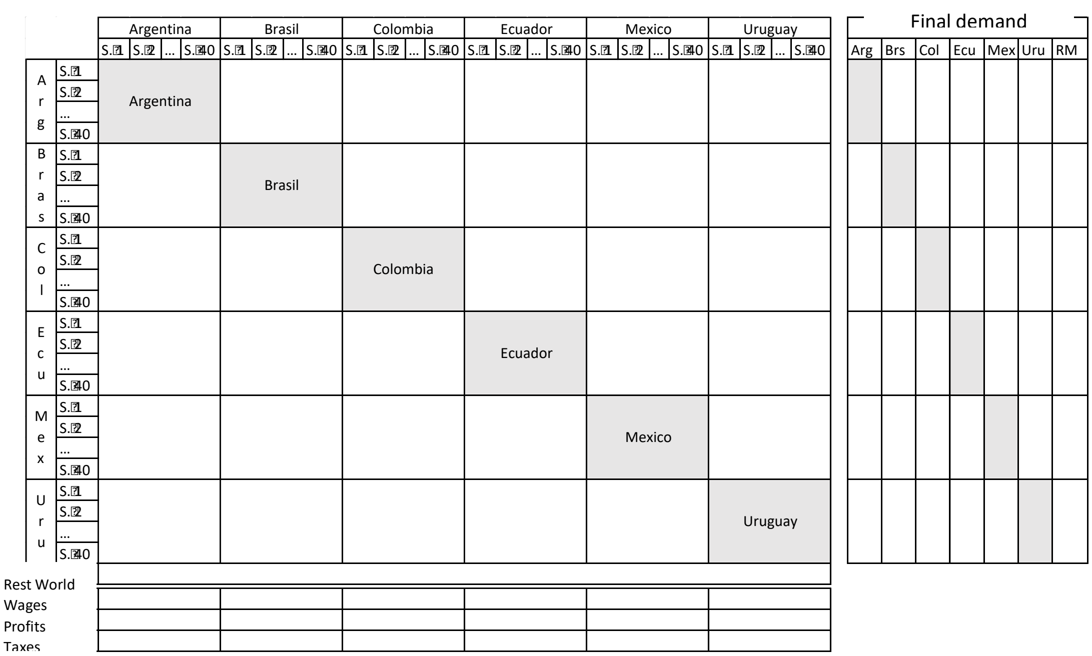
Source: World Bank, EORA Project.

It should be noted that the automotive sector provides a greater contribution in the three economies that manufacture the most in the region, the highest being Mexico where it is slightly above 4%.

III-3.2 Data

This work relies on multiple data sources and a great deal of data processing. Annex III.3 of this study: Data further develops the characteristics of the data sources and the techniques used to organize the information. However, **Table 29** gives an idea of the work carried out with this diagram so as to understand the most important information structure used.

Table 29. Multi-regional Input-output Matrices Diagram



For this analysis, information was collected from the exchange of information within each country by 40 economic sectors. The sectors that were used are described in the Data Appendix. To simplify the presentation in the diagram, the sectors are sequentially numbered and generically indicated as S.1, or Sector 1, S.2 for Sector 2, etc.

Table 29 is schematically organized in three rectangles. The central rectangle represents the purchases and sales of intermediate production supplies in the economies under study. The rectangle on the right, entitled Final Demand, represents the consumption of final goods and investment made in the economies. Finally, the rectangle at the bottom of the diagram represents wage payments, gross operating surpluses that can be associated with the profits generated by each sector of the economy and finally the payment of indirect taxes that are made in each economy.

Taking Argentina as an example, the gray rectangle with the name of Argentina represents the operations of purchase and sale of production supplies made within Argentina among the 40 economic sectors of the country. In this country, when reading the information from each row, one can see the amount of sales in monetary terms made during one year by each of the 40 sectors, to each of the other 40 sectors of the Argentine economy. The gray rectangle with the name of Argentina therefore represents a matrix of dimension 40x40, where each position of the matrix indicates the amount of sales that the row sector sold to the column sector.

Likewise, each of the gray rectangles represents the purchases and sales of production inputs that take place among the 40 sectors that make up all the economies under study.

Foreign trade information on supplies is captured in the rectangles that are not highlighted in gray. Thus, for example, if the diagram is read from the row representing Brazil, and combined with the column representing Mexico, a matrix of 40x40 sectors is once more obtained. This matrix represents Brazil's supply exportation from each of its 40 sectors for the production of each of Mexico's 40 sectors.

The Final Demand rectangle provides information on sales of final goods within each country, and between countries. The gray rectangles in this area represent the internal demand in each country. Thus, if an Ecuadorian family buys a vehicle manufactured in Ecuador, the expenditure made by that family is recorded in the column corresponding to Ecuador, in intersection with sector number 30, motor vehicles, trailers and semi-trailers, in the row for the country Ecuador. If the family had purchased a vehicle manufactured in Brazil, the family's expenditure would be recorded in the same column, but this time in sector number 30 of the block of sectors that coincides with Brazil.

Note that the Final Demand block has a final column with the name of R.W. (Rest of the World). In this column, information is recorded on the purchase of a vehicle by a family that is not in any of the six countries under analysis, but which generates an import from one of these six countries.

Finally, the rectangle in the lower box holds information regarding the amount of wages, operating surplus and indirect taxes generated by each of the sectors in all of the economies under analysis.

There are two main sources for organizing all the information in the matrix. First, the work carried out by ECLAC (CEPAL 2016) and second, the EORA project (Lenzen, Kanemoto, y otros 2012) and (Lenzen, Moran, y otros 2013). The corresponding annex describes the technique used to organize these two sources.

Finally, the characteristics of consumption in each country were determined through calibration that is consistent with the final demand structure of the Input and Output tables used.

III-3.3 Results

A base scenario depicts the most realistic outcome expected based on a set of postulated mechanisms. Hence, in this base scenario, it is expected that by adopting the UN Regulations, the six countries will have additional economic growth at a rate of 0.81% of the total Gross Domestic Product compared to 2015.

This total income would be distributed among the six countries as shown in **Figure 49**. The country that would experience the greatest growth would be Argentina, while Mexico would benefit the least as a result of the lower trade interaction in the region.

In the case of Argentina, 1.04% represents additional growth in relation to the country's growth in 2015, if its entire fleet of vehicles had the technology recommended in this report. This figure arises as a result of the changes in consumption generated in the country and the changes in foreign trade caused by international standardization. The figures presented in the graph for the other countries must be read in the same way.

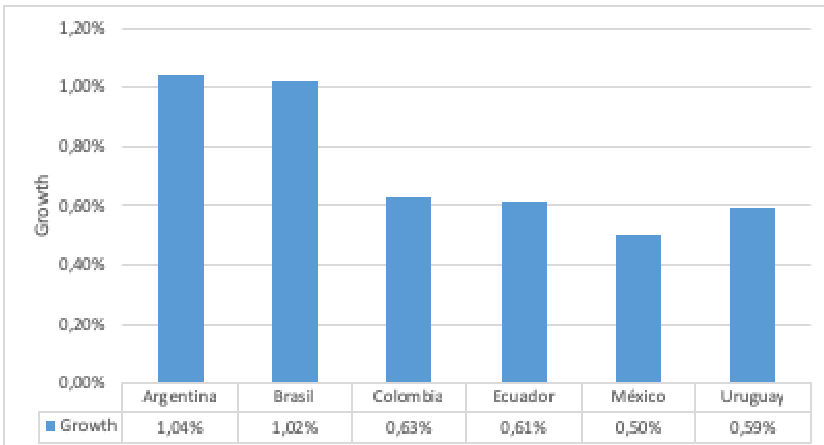


Figure 49. GDP growth in addition to that recorded in 2015 for each country

Source: own production

The results can be organized into three groups. First, Argentina and Brazil, which are the countries that have benefited the most and, together with Mexico, are the largest producers in the region. Then, the countries with low vehicle production: Colombia, Ecuador and Uruguay that obtain a very similar benefit. Finally, Mexico does not seem to receive the positive effects of being a large producer. This is a consequence of the limited relative trade interaction between the Mexican vehicle production sector and the rest of Latin America.

If production technology remains unchanged in relation to 2015, employment growth is expected in all countries as shown in **Figure 50**. The number of jobs expected is obtained by dividing the excess income directed toward labor generated by the policy intervention discussed in this chapter by an approximation of the average annual salary in the country.

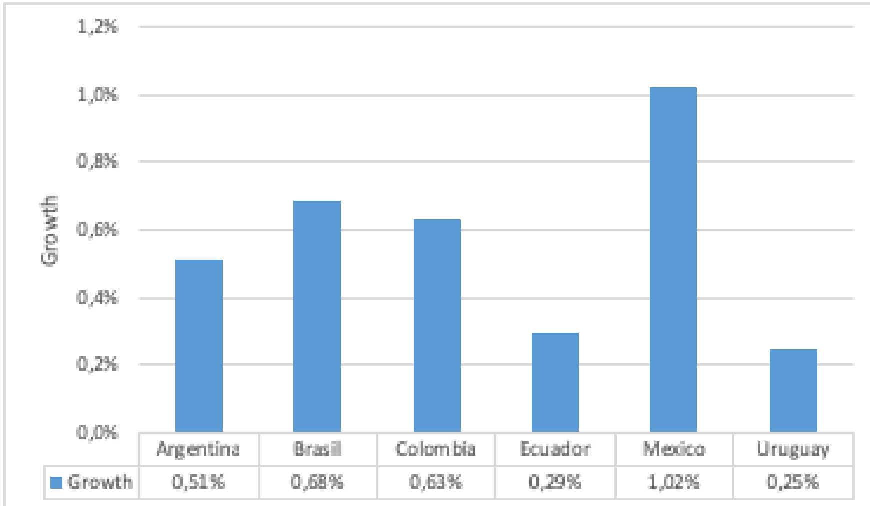


Figure 50. Additional employment growth compared to 2015

Source: IADB

The highest impact on employment would occur in Mexico, even though it is the country with the lowest overall GDP growth. This can be explained by the interaction of two forces. First, Mexico is the country with the largest contribution in terms of manufacturing among the six countries under analysis. This means that any change in the sector gains more traction over the entire economy. Second, Mexico's average wage is among the lowest in the region. Therefore, the combination of these two forces creates a large effect on employment, despite having little effect on added value.

Considering a tax on production structure, the approximate net difference between tariffs and subsidies for each country and the value-added taxes, tax income for each country could increase in relation to the income for 2015. The percentages of this growth per country are shown in **Figure 51**. These figures show the increase in tax collection with respect to the information available at the World Bank for the year 2015, which would be generated by the introduction of the regulations in all countries.

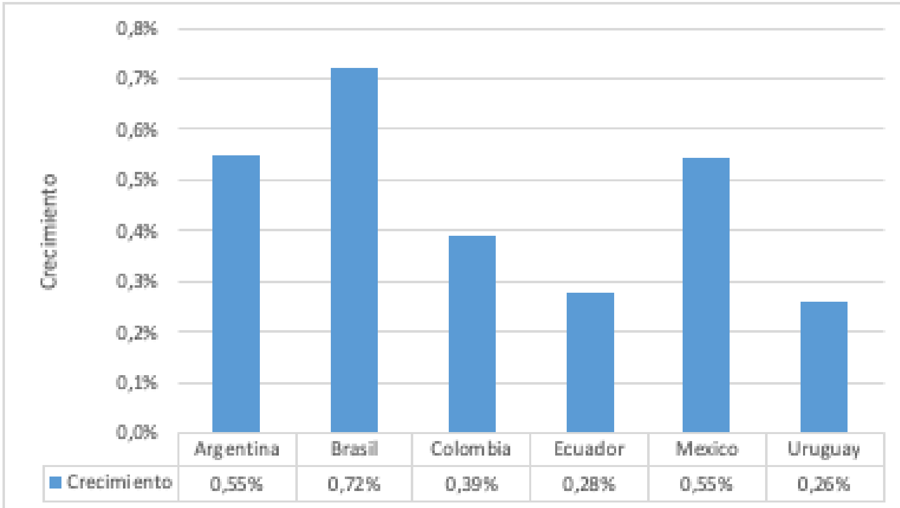


Figure 51. Increase of Tax Income in Comparison with 2015

Source: IADB

III-3.4 Breakdown of the resulting effects

It is possible to break down the growth indicators presented above into the two effects studied. First, the effect generated by the regulations by reducing the consequences of road crashes, and second the effect of the hypotheses linked to foreign trade.

Given the general equilibrium characteristics of the model, it is difficult to decouple foreign trade effects in each case. However, it is possible to disaggregate the effects according to their intensity, and use this information to break down the total aggregate effect presented in **Table *30***. This breakdown exercise is carried out by simulating different contexts. To analyze the effect of road crashes, countries are considered on an individual basis without trade interaction between them. The trade simulation is the sum of three effects: the knock-on effect of trade between countries produced by economic activity generated by spending on non-health goods, the change in inter-regional trade, and the change in extra-regional trade.

Table 31 shows how much of the effect of the reduction in road crashes and changes in trade influence the expected growth rate. It should be noted that the effect of reducing road crashes on GDP growth is greater than the effect generated by foreign trade for each of the countries.

Table 30. Contribution of road crash reduction and trade to change in GDP

Country	Incidents	Trade	Total Effect
Argentina	0.56% (54%)	0.48% (46%)	1.04%
Brazil	0.70% (68%)	0.32% (32%)	1.02%
Colombia	0.51% (81%)	0.12% (19%)	0.63%
Ecuador	0.51% (84%)	0.10% (16%)	0.61%
Mexico	0.40% (79%)	0.10% (21%)	0.50%
Uruguay	0.49% (83%)	0.10% (17%)	0.59%
Source: own production * The relative contribution to the total effect in the country appears in the parentheses			

Note the limited trade effect for Mexico in relation to Brazil and Argentina. This points to low trade interaction with Mexico in the region in general as mentioned above.

III-3.5 Sensitivity analysis

How much vehicle safety technology generates a positive impact on the economy depends on a number of key mechanisms described above. These mechanisms have parameters that determine the intensity of their effects. In this section, we will study how the results change when these intensities change.

The previous section showed the consequences of changes in terms of the economy's income, employment and changes in government revenue. The sensitivity analysis will be conducted only on the effect on the income change of the entire economy. The relationship with the other variables is unvarying, and does not need to be presented for each case.

One of the most important mechanisms is avoided costs for households. When households have fewer crashes, they stop spending on healthcare. Hence, the money that used to be spent on healthcare will be spent on non-health goods and on savings. The savings rate determines which part is allocated to consumption and which part is saved. In the base model, the savings rate was calibrated with data from family expenditure surveys in each country for 2015. Savings behavior varies greatly depending on household income and the business cycle in which the survey is conducted. The calibration was conducted accounting for savings made by households in the pension system, education, financial savings and durable goods.

Figure *52* analyzes the changes in GDP generated by various percentage changes in the savings rate. For example, in the group of chart bars for Uruguay, we can see what would happen if the savings rate were increased by 25%, 50%, 75% or 100%. The data show that the GDP of Ecuador and Argentina are more sensitive to changes in the savings rate. But in all cases, the GDP does not show significant variations in function of the changes in the savings rate.

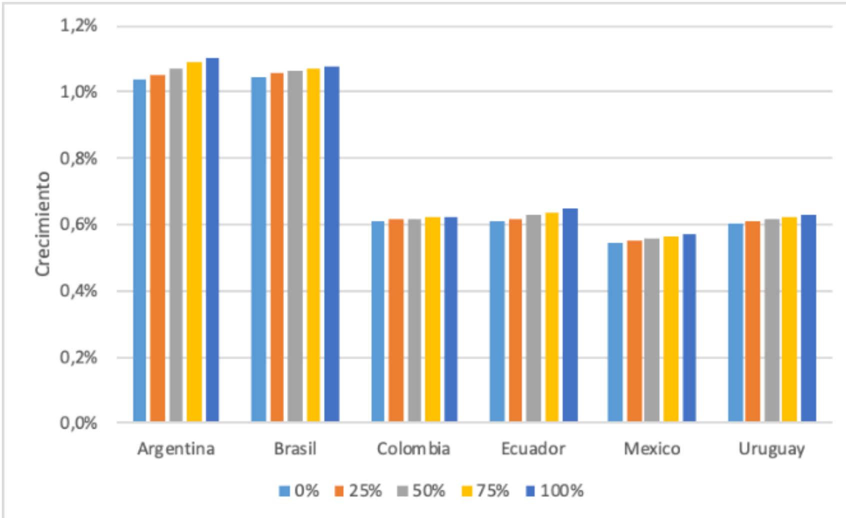


Figure 52. Changes in GDP in response to increases in the savings rate

Source: own production

The operating hypotheses of foreign trade have intensity parameters that are worth studying in terms of their sensitivity. Hence, as a result of regional standardization, there is a percentage of demand from non-producing countries in the region that could be met by producing countries. For countries that are net importers, the assumption is made that they would substitute part of the demand from outside the region with regional producers. The demand they would substitute is the demand of vehicle producers they make from peripheral countries. This demand represented approximately 360,000 vehicles in the region in 2015.

Table 31. Variations in GDP due to changes in regional sales

Country	Substitution of Imports from Outside the Region					
	0%	**10%**	**20%**	**30%**	**40%**	**50%**
Argentina	0.98%	1.01%	1.03%	1.04%	1.05%	1.07%
Brazil	0.99%	1.01%	1.02%	1.02%	1.03%	1.04%
Colombia	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%
Ecuador	0.60%	0.61%	0.61%	0.61%	0.61%	0.62%
Mexico	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Uruguay	0.58%	0.59%	0.59%	0.59%	0.59%	0.60%

The first row of **Table 31** shows the percentage of imports from peripheral countries that would be replaced by local producers. The base scenario was assumed a 30% substitution and this is indicated by the gray column. Changes in GDP are not sensitive to changes in the value of this demand. This becomes even more obvious for countries without a highly-developed automotive industry.

However, the sensitivity is different when analyzing what would happen to changes in exports of auto parts to the rest of the world. **Figure *53*** shows how each country responds to different assumptions regarding the contribution of the Latin American industry in the global auto parts supply sector. In the first place, it is important to remember that the assumption is that the most reactive economies are those that already have national auto parts production sectors. According to the chart, Argentina, Brazil and Mexico are therefore the economies that respond with the greatest sensitivity.

The first bar for each country is the total GDP growth generated if there were no additional industry contribution in the world market. While the last bar for each country represents the effect it would have on the economies of each country if the contribution were 6%, which is the share of Latin American production in world production.

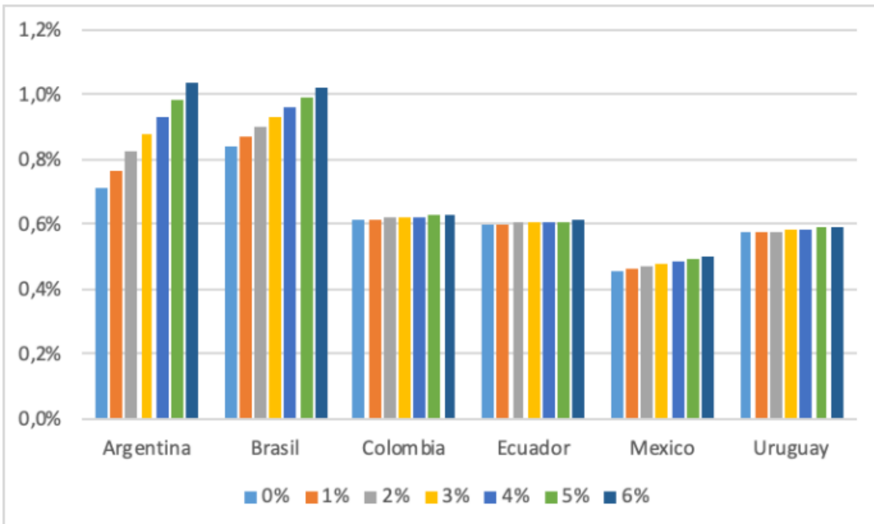


Figure 53. Changes in Extra-regional Exports of Auto Parts

Source: own production

Finally, the effect of total redistributed spending on other expenses for each economy was analyzed. As a result of the introduction of vehicle safety technologies, there are fewer road crashes, and therefore households now no longer have to spend their money on health services. **Figure 54** shows how the economies under study respond to different volumes of redistributed spending.

For example, the first group of bars on the left represents what would happen if the volume of spending reallocated is 0.2% of the GDP. Similarly, the rightmost group of bars represents what would happen to each economy if the volume of expenditures redistributed were 1.4%.

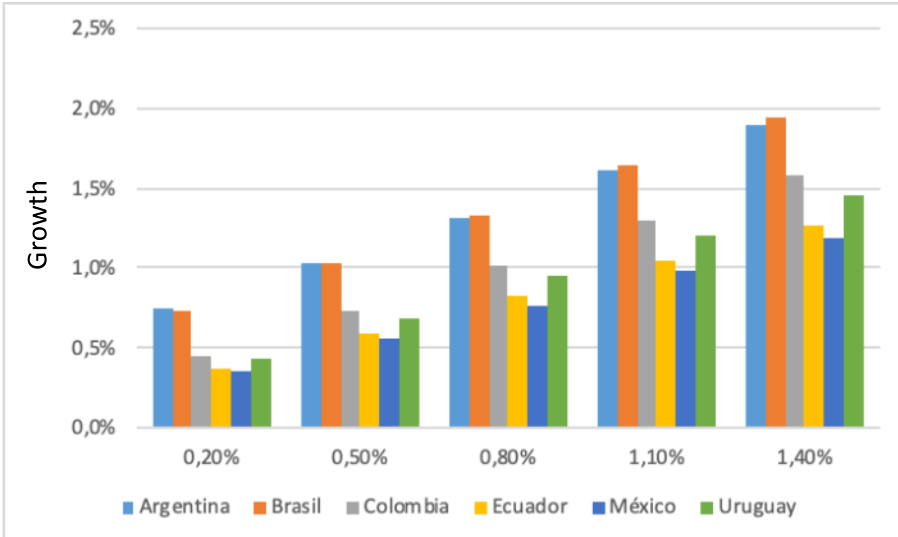


Figure 54. Changes in health costs reallocated for the other expenses

Source: own production

To serve as a reference, in the base model that was used the share of redistributed spending is 0.59% for Argentina, 0.41% for Brazil, 0.23% for Colombia, 0.36% for Ecuador, 0.32% for Mexico and finally 0.31% for Uruguay. In other words, the results of the base model are between the first and second group of columns in the chart.

The proportion of expenses redistributed depends on the health spending that no longer required to cover the costs of vehicle crashes. In turn, the health spending that is no longer required depends on the number of road crashes avoided by improving safety technology and the cost of each road crash on average.

This sensitivity analysis is important because it reflects the range of variation that results can have due to errors in the estimates of health costs carried out in this part. This is clearly a sensitive parameter and has significant effects on the growth of the entire economy.

CHAPTER III.4. Conclusions

This section provided an economic analysis of the impact of the UN Regulations developed by WP.29 and recommended in this study. Under the assumption that all the countries of the region demand approvals according to the UN Regulations, two types of effects were studied and integrated in a general multisectoral and multiregional balance model: first, the reduction of road crashes and their negative consequences thanks to the increase in vehicle safety, and second, the changes in foreign trade generated by the reduction in the cost of vehicle approval.

The analysis is carried out within the framework of two main assumptions. First, it is assumed that the entire vehicle fleet of each country adopts the technology recommended in this study simultaneously. Second, even though the analysis is carried out on Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay, it is assumed that all the countries in the region adopt the regulations at the same time. Due to improved data availability, the results are presented for 2015.

From the results obtained, it can be stated that all the improvements in technology suggested in this study increase economic growth and the development of the economies under consideration. The model analyzed shows a positive association between the size of the countries' car production sector and GDP growth. Thus, Argentina and Brazil have value-added growth of slightly more than 1%. Mexico breaks this association because, despite being the largest car producer among the countries analyzed, the growth it obtains by approving the suggested UN regulations is 0.5%. This result is the outcome of Mexico's low level of commercial interaction with Latin American countries in the automotive sector. Finally, the countries with smaller automotive sectors, Colombia, Ecuador and Uruguay, would obtain an increase of 0.6% in gross domestic product.

These results should be qualified in light of the two assumptions adopted above. It should be noted that the figures presented indicate the potential positive effect on the economy that would be generated in all the cases analyzed. Economic growth expands the space of opportunity for households and this larger group of choice improves the quality of life in the country.

The results obtained allow us to state with certainty that the effects of updating safety technologies on the vehicle fleet are positive for society. Governments are challenged to visualize the most efficient and effective strategies to update the vehicle fleet. Economic policy instruments must be properly organized to meet different interests. For example, changing consumer preferences towards safer and cleaner cars helps to accelerate the process.

However, in low- and middle-income countries such as those in Latin America, consumers are very sensitive to price, so sellers can still find large market segments where they can sell lower-performance technology in exchange for price reductions. This is why the corresponding administrations should also consider regulating insurance companies to support the adoption of safer technology by correcting not only household preferences but also their incentives through changing insurance prices.

Finally, the worldwide harmonization of a set of international requirements offers the possibility to create joint industrial policies between the private sector and the state, for the development of a world-class auto-parts supply sector. The development of industrial policies to achieve these objectives is an opportunity that should be considered at regional level, and not at country level. The challenges to update technologies are numerous, but the development opportunities for regional economies make it worthwhile to embark on this process and apply the necessary effort to improve vehicle safety technology.

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GENERAL CONCLUSIONS OF THE STUDY

Given the evidence presented in this study and the high rates of fatalities and injuries due to road crashes in the LAC region, it is imperative to improve each country's national regulatory system. According to WHO data, if rapid action is not taken to improve road safety, the number of road traffic deaths could increase by 80% in low- and middle-income countries over the next two years.

Likewise, the regulatory system of the 1958 Agreement and the UN Regulations annexed to that Agreement should be adopted without modification. This should be the regulatory basis for each country in the region, which has the added benefit of harmonizing regional regulations with regulations common around the globe. It is also important to stress that only type-approval certificates issued and signed by the Contracting Parties to the 1958 Agreement administered by the World Forum WP.29 are valid

Furthermore, consumer information systems like Latin NCAPs, which are a catalyst for the market by informing the consumer and exposing safety deficiencies in the region's models, are essential. NCAP systems have proven to be effective in combination with effective regulatory systems.

These two actions can reduce the number of fatalities and injuries in the LAC region due to traffic crashes and would also reduce emissions levels, positively impacting the health of the region's inhabitants as shown by the University of Chicago's social impact assessment.

There is considerable evidence that vehicle design technologies have had a major impact reducing road traffic fatalities and injuries in countries with mature economies. The objective of this report was to answer the question: "How many fatalities and injuries could be avoided if proven technologies and improvements in vehicle design were available in Latin America and the Caribbean?" The study shows that there are several technologies which can have a significant effect on reducing road traffic injuries. Notably:

Increasing the availability of ESC would lead to lives saved and disabilities averted in passengers, pedestrians and motorcyclists. Many of these benefits are derived from ABS technology, which is included in ESC. ABS technology for motorcycles is one of the few vehicle technologies that can have a substantial impact on reducing injuries in countries where motorcyclists comprise a large proportion of the dead and injured.

The increased use of passenger protection technologies, including safety belts, frontal and side airbags, and side padding will have a large impact on the number of deaths in road crashes in countries where passengers comprise a large proportion of the dead and injured (as is the case in Argentina). All this is complemented by a vehicle structure that keeps the passenger cabin intact.

Safety belts are a highly effective technology that is already available in almost all cars in the region, but their use remains low. Regional governments need to strengthen enforcement of seatbelt laws in order to reap the benefit of the technology.

Pedestrians in the region can benefit substantially from the design of the front of the vehicle.

This analysis assumes that the benefits of these technologies applied in the LAC region would be similar to those of countries with mature economies. However, simply providing a particular technology is not sufficient, as obtaining the full benefits of the technologies often requires basic structural design. Therefore, although the analysis focuses on assessing the effect of the technologies, it is not intended to promote any particular technology. Rather, the analysis aims to highlight the potential benefits of improving vehicle design.

In that regard, two key mechanisms have driven the evolution of vehicle safety performance in countries with mature economies. First, the establishment of regulations that require all cars sold to provide a minimum threshold of safety performance. Second, countries with mature economies have established evaluation programs for new cars, where cars are tested under more stringent conditions and change more frequently than the regulations themselves. Safety ratings from NCAP programs have a strong influence on consumer choices and create strong market forces for manufacturers to improve vehicle safety design. In fact, there is ample evidence that in the USA, car manufacturers are responding to changing requirements in NCAP testing by redesigning vehicles to be safer. Typically, this means improving the performance of individual technologies and optimizing the way they work together to provide maximum safety benefits. In the USA, these market forces have led to substantial improvements in real-world crash performance across the entire vehicle fleet.

Similarly, improvements in vehicle design can drastically reduce the risk of fatalities and injuries in road traffic crashes in the LAC region. Countries in the region should adopt design regulations for vehicle safety, such as the UN Regulations developed by WP.29 for cars to provide a basic safety threshold. There is also a need to create market mechanisms, such as NCAP's star rating programs, to encourage manufacturers to make safer vehicle designs available in the region.

An economic analysis of the impact of the UN Regulations developed by WP.29 and recommended in this study was presented in this work. Making the assumption that all countries in the region require approvals under the UN Regulations, three types of effects were studied together. First, the reduction of the number of road crashes that are generated by increasing the safety of vehicles. Second, the reduction in the number of deaths and illnesses by reducing the emission of pollutants. Third and finally, the requirement for approval in accordance with UN regulations in the region generates foreign trade effects that impact the countries involved in different ways.

The overall impact of these three effects for the entire region, measured in terms of income for citizens, is positive. The introduction of the recommended UN Regulations would mean that vehicles would have the appropriate technology to reduce road crashes. This would generate an expected increase of 0.81% in the combined Gross Domestic Product of Argentina, Brazil, Colombia, Ecuador, Mexico and Uruguay.

The results of the economic impact analysis conducted show that improving vehicle safety and emission technology helps the development and economic growth of all countries in the region. The well-being of the entire population increases as more households improve access to the public goods offered by their economies. The life expectancy of the entire population increases. Economic growth increases due to the effects of improved health on people's productive capacity. Households increase their savings to plan for a longer life and this also generates greater income for the entire economy.

States and their administrations have no excuse for not embarking on the project of updating regulations and incorporating the necessary technologies into vehicle fleets. Regional governments must visualize the most efficient and effective strategies to update the fleet in the context of their own industrial sector. Economic policy instruments must be properly organized. On the one hand, updating the fleet can be accelerated by modifying consumer preferences and altering user incentives. On the other hand, appropriate industrial policies can also aid in this process.

Changing consumer preferences towards safer and cleaner cars helps accelerate the evolution of the vehicle fleet. Organizations such as Latin NCAP can play a key role in the process of changing consumer preferences by making information accessible to all households.

However, in low- and middle-income countries such as those in Latin America and the Caribbean, consumers are very sensitive to price, so sellers can still find large market segments for lower-quality technology at a lower price. This is why the corresponding administrations should also think about tax incentives for safer and less polluting vehicles as well as regulation of insurance companies to correct household preferences and incentives.

Finally, there are many challenges to adopting new technology, but the development opportunities for regional economies make the effort worthwhile.

SCHEDULES

PART I SCHEDULES

Schedule I-1. 1958 Agreement

Title of the Agreement: Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions, done at Geneva on 20 March 1958. This Agreement is known as the 1958 Agreement. This Revision 3 entered into force on 14 September 2107.

The text of Revision3 of the 1958 Agreement is available is available on the WP29 World Forum Website WP.29 in the three official languages of the United Nations Economic Commission for Europe (UNECE)Q at http://www.unece.org/trans/main/wp29/wp29regs.html. However, the secretariat of the WP.29 is in the process of updating a publication on the WP29 World Forum, its functioning and how to join it, which contains the text of the Agreement. The publication is usually translated into the six official UN languages (English, French, Russian, Spanish, Arabic and Chinese). This publication will be available at: http://www.unece.org/index.php?id=2077.

As the European Union is a Contracting Party to the 1958 Agreement, the European Commission has translated the text of Revision 3 of the Agreement into all EU languages. The Agreement is available at: https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A52015PC0535

Even though the text of Revision 3 of the 1958 Agreement can be found in all EU languages, the prevailing versions are those available on the WP.29 website, i.e., the English, French and Russian versions, which are the ones that have been formally adopted by the WP29 World Forum.

Schedule I-2. List of UN Regulations annexed to the 1958 Agreement

The list of UN Regulations adopted by the WP29 World Forum is reproduced below in English and Spanish. The text of the UN Regulations translated by the services of the European Commission into all the official languages of the European Union is available at:

https://www.bing.com/search?q=translation+of+unece+regulations+in+the+area+of+vehicle+approval&form=EDGEAR&qs=PF&cvid=a277fb6648b24ac1b06f5e82d8589ffb&cc=CH&setlang=es-ES.

Table A1. List of UN Regulations annexed to the 1958 Agreement

UN Regulation	*Title*
0	Uniform provisions concerning the International Whole Vehicle Type Approval (IWVTA)
1 and 2	Uniform provisions concerning the approval of motor vehicle headlamps emitting an asymmetrical passing-beam and/or a driving-beam and equipped with filament lamps of categories R_2 and/or HS_1 Uniform provisions concerning the approval of incandescent electric lamps for headlamps emitting an asymmetrical passing-beam or a driving-beam or both
3	Uniform provisions concerning the approval of retro-reflecting devices for power-driven vehicles and their trailers
4	Uniform provisions concerning the approval of devices for the illumination of rear registration plates of power-driven vehicles and their trailers
5	Uniform provisions concerning the approval of power-driven vehicle's "sealed beam" headlamps (SB) emitting a European asymmetrical passing-beam or a driving-beam or both
6	Uniform provisions concerning the approval of direction indicators for power-driven vehicles and their trailers
7	Uniform provisions concerning the approval of front and rear position lamps, stop-lamps and end-outline marker lamps for motor vehicles (except motor cycles) and their trailers
8	Uniform provisions concerning the approval of motor vehicle headlamps emitting an asymmetrical passing-beam or a driving-beam or both and equipped with halogen filament lamps (H_1, H_2, H_3, HB_3, HB_4, H_7, H_8, H_9, HIR_1, HIR_2 and/or H_{11})

UN Regulation	Title
9	Uniform provisions concerning the approval of category L_2, L_4 and L_5 vehicles with regard to noise
10	Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
11	Uniform provisions concerning the approval of vehicles with regard to door latches and door retention components
12	Uniform provisions concerning the approval of vehicles with regard to the protection of the driver against the steering mechanism in the event of impact
13	Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking
13-H	Uniform provisions concerning the approval of passenger cars with regard to braking
14	Uniform provisions concerning the approval of vehicles with regard to safety-belt anchorages, ISOFIX anchorages systems, ISOFIX top tether anchorages and i-Size seating positions
15	This UN Regulation is obsolete
16	Uniform provisions concerning the approval of: I. Safety-belts, restraint systems, child restraint systems and ISOFIX child restraint systems for occupants of power-driven vehicles II. Vehicles equipped with safety-belts, safety-belt reminder, restraint systems, child restraint systems, ISOFIX child restraint systems and i-Size child restraint systems
17	Uniform provisions concerning the approval of vehicles with regard to the seats, their anchorages and any head restraints
18	Uniform provisions concerning the approval of motor vehicles with regard to their protection against unauthorized use
19	Uniform provisions concerning the approval of power-driven vehicle front fog lamps
20	Uniform provisions concerning the approval of motor vehicle headlamps emitting an asymmetrical passing-beam or a driving-beam or both and equipped with halogen filament lamps (H_4 lamps)
21	Uniform provisions concerning the approval of vehicles with regard to their interior fittings

UN Regulation	Title
22	Uniform provisions concerning the approval of protective helmets and their visors for drivers and passengers of motor cycles and mopeds
23	Uniform provisions concerning the approval of reversing and manoeuvring lamps for power-driven vehicles and their trailers
24	Uniform provisions concerning: I. The approval of compression ignition (C.I.) engines with regard to the emission of visible pollutants II. The approval of motor vehicles with regard to the installation of C.I. engines of an approved type III. The approval of motor vehicles equipped with C.I. engines with regard to the emission of visible pollutants by the engine IV. The measurement of power of C.I. engine
25	Uniform provisions concerning the approval of head restraints (headrests), whether or not incorporated in vehicle seats
26	Uniform provisions concerning the approval of vehicles with regard to their external projections
27	Uniform provisions for the approval of advance-warning triangles
28	Uniform provisions concerning the approval of audible warning devices and of motor vehicles with regard to their audible signals
29	Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants of the cab of a commercial vehicle
30	Uniform provisions concerning the approval of pneumatic Tires for motor vehicles and their trailers
31	Uniform provisions concerning the approval of power-driven vehicle's halogen sealed-beam headlamps (HSB) emitting an European asymmetrical passing beam or a driving beam or both
32	Uniform provisions concerning the approval of vehicles with regard to the behavior of the structure of the impacted vehicle in a rear-end collision
33	Uniform provisions concerning the approval of vehicles with regard to the behavior of the structure of the impacted vehicle in a head-on collision
34	Uniform provisions concerning the approval of vehicles with regard to the prevention of fire risks

UN Regulation	Title
35	Uniform provisions concerning the approval of vehicles with regard to the arrangement of foot controls
36	Uniform provisions concerning the approval of large passenger vehicles with regard to their general construction (As from 1 April 2008, no new approvals shall be granted under this UN Regulation. The provisions contained into this UN Regulation have been include into UN Regulation No. 107)
37	Uniform provisions concerning the approval of filament lamps for use in approved lamp units of power-driven vehicles and of their trailers
38	Uniform provisions concerning the approval of rear fog lamps for power-driven vehicles and their trailers
39	Uniform provisions concerning the approval of vehicles with regard to the speedometer equipment including its installation
40	Uniform provisions concerning the approval of motor cycles equipped with a positive-ignition engine with regard to the emission of gaseous pollutants by the engine
41	Uniform provisions concerning the approval of motorcycles with regard to noise
42	Uniform provisions concerning the approval of vehicles with regard to their front and rear protective devices (bumpers, etc.)
43	Uniform provisions concerning the approval of safety glazing materials and their installation on vehicles
44	Uniform provisions concerning the approval of restraining devices for child occupants of power-driven vehicles ("Child Restraint System")
45	Uniform provisions concerning the approval of headlamp cleaners, and of power-driven vehicles with regard to headlamp cleaners
46	Uniform provisions concerning the approval of devices for indirect vision, and of motor vehicles with regard to the installation of these devices
47	Uniform provisions concerning the approval of mopeds equipped with a positive-ignition engine with regard to the emission of gaseous pollutants by the engine
48	Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light-signalling devices

UN Regulation	Title
49	Uniform provisions concerning the measures to be taken against the emission of gaseous and particulate pollutants from compression-ignition engines and positive ignition engines for use in vehicles
50	Uniform provisions concerning the approval of front position lamps, rear position lamps, stop lamps, direction indicators and rear-registration-plate illuminating devices for vehicles of category L
51	Uniform provisions concerning the approval of motor vehicles having at least four wheels with regard to their sound emissions
52	Uniform provisions concerning the approval of M_2 and M_3 small capacity vehicles with regard to their general construction (As from 1 April 2008, no new approvals shall be granted under this UN Regulation. The provisions contained into this UN Regulation have been include into UN Regulation No. 107)
53	Uniform provisions concerning the approval of category L_3 vehicles with regard to the installation of lighting and light-signalling devices
54	Uniform provisions concerning the approval of pneumatic Tires for commercial vehicles and their trailers
55	Uniform provisions concerning the approval of mechanical coupling components of combinations of vehicles
56	Uniform provisions concerning the approval of headlamps for mopeds and vehicles treated as such
57	Uniform provisions concerning the approval of headlamps for motor cycles and vehicles treated as such
58	Uniform provisions concerning the approval of: I. Rear underrun protective devices (RUPDs) II. Vehicles with regard to the installation of a RUPD of an approved type III. Vehicles with regard to their rear underrun protection (RUP)
59	Uniform provisions concerning the approval of replacement silencing systems
60	Uniform provisions concerning the approval of two-wheeled motor cycles and mopeds with regard to driver-operated controls including the identification of controls, tell-tales and indicators

UN Regulation	*Title*
61	Uniform provisions concerning the approval of commercial vehicles with regard to their external projections forward of the cab's rear panel
62	Uniform provisions concerning the approval of power-driven vehicles with handlebars with regard to their protection against unauthorized use
63	Uniform provisions concerning the approval of two-wheeled mopeds with regard to noise
64	Uniform provisions concerning the approval of vehicles with regard to their equipment which may include: a temporary use spare unit, run flat Tires and/or a run flat-system, and/or a Tire pressure monitoring system
65	Uniform provisions concerning the approval of special warning lamps for power-driven vehicles and their trailers
66	Uniform provisions concerning the approval of large passenger vehicles with regard to the strength of their superstructure
67	Uniform provisions concerning the approval of: I. Specific equipment of vehicles of category M and N using liquefied petroleum gases in their propulsion system II. Vehicles of category M and N fitted with specific equipment for the use of liquefied petroleum gases in their propulsion system with regard to the installation of such equipment
68	Uniform provisions concerning the approval of power-driven vehicles including pure electric vehicles with regard to the measurement of the maximum speed
69	Uniform provisions concerning the approval of rear marking plates for slow-moving vehicles (by construction) and their trailers
70	Uniform provisions concerning the approval of rear marking plates for heavy and long vehicles
71	Uniform provisions concerning the approval of agricultural tractors with regard to the driver's field of vision
72	Uniform provisions concerning the approval of motor cycle headlamps emitting an asymmetrical passing-beam and a driving-beam and equipped with halogen filament lamps (HS_1 lamps)

UN Regulation	Title
73	Uniform provisions concerning the approval of: I. Vehicles with regard to their lateral protection devices (LPD) II. Lateral protection devices (LPD) III. Vehicles with regard to the installation of LPD of an approved type according to Part II of this Regulation
74	Uniform provisions concerning the approval of category L_1 vehicles with regard to the installation of lighting and light-signalling devices
75	Uniform provisions concerning the approval of pneumatic Tires for motor cycles and mopeds
76	Uniform provisions concerning the approval of headlamps for mopeds emitting a driving-beam and a passing-beam
77	Uniform provisions concerning the approval of parking lamps for power-driven vehicles
78	Uniform provisions concerning the approval of vehicles of category L_1, L_2, L_3, L_4 and L_5 with regard to braking
79	Uniform provisions concerning the approval of vehicles with regard to steering equipment
80	Uniform provisions concerning the approval of seats of large passenger vehicles and of these vehicles with regard to the strength of the seats and their anchorages
81	Uniform provisions concerning the approval of rear-view mirrors of two-wheeled power-driven vehicles with or without side car, with regard to the mounting of rear-view mirrors on handlebars
82	Uniform provisions concerning the approval of moped headlamps equipped with filament halogen lamps (HS_2)
83	Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements
84	Uniform provisions concerning the approval of power-driven vehicles equipped with internal combustion engines with regard to the measurement of fuel consumption
85	Uniform provisions concerning the approval of internal combustion engines or electric drive trains intended for the propulsion of motor vehicles of categories M and N with regard to the measurement of the net power and the maximum 30 minutes power of electric drive trains
86	Uniform provisions concerning the approval of agricultural or forestry vehicles with regard to the installation of lighting and light-signalling devices

UN Regulation	Title
87	Uniform provisions concerning the approval of daytime running lamps for power-driven vehicles
88	Uniform provisions concerning the approval of retroreflective Tires for two-wheeled vehicles
89	Uniform provisions concerning the approval of: I. Vehicles with regard to limitation of their maximum speed or their adjustable speed limitation function II. Vehicles with regard to the installation of a speed limitation device (SLD) or adjustable speed limitation device (ASLD) of an approved type III. Speed limitation devices (SLD) and adjustable speed limitation device (ASLD)
90	Uniform provisions concerning the approval of replacement brake lining assemblies, drum-brake linings and discs and drums for power-driven vehicles and their trailers
91	Uniform provisions concerning the approval of side-marker lamps for motor vehicles and their trailers
92	Uniform provisions concerning the approval of non-original replacement exhaust silencing systems (RESS) for motorcycles, mopeds and three-wheeled vehicles
93	Uniform provisions concerning the approval of: I. Front underrun protective devices (FUPDs) II. Vehicles with regard to the installation of an FUPD of an approved type III. Vehicles with regard to their front underrun protection (FUP)
94	Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a frontal collision
95	Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a lateral collision
96	Uniform provisions concerning the approval of compression ignition (C.I.) engines to be installed in agricultural and forestry tractors and in non-road mobile machinery with regard to the emissions of pollutants by the engine
97	Uniform provisions concerning the approval of vehicle alarm systems (VAS) and of motor vehicles with regard to their alarm systems (AS)
98	Uniform provisions concerning the approval of motor vehicle headlamps equipped with gas-discharge light sources

UN Regulation	*Title*
99	Uniform provisions concerning the approval of gas-discharge light sources for use in approved gas-discharge lamp units of power-driven vehicles
100	Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train
101	Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range and of categories M_1 and N_1 vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range
102	Uniform provisions concerning the approval of: I. A close-coupling device (CCD) II. Vehicles with regard to the fitting of an approved type of CCD
103	Uniform provisions concerning the approval of replacement pollution control devices for power-driven vehicles contents
104	Uniform provisions concerning the approval of retro-reflective markings for vehicles of category M, N and O
105	Uniform provisions concerning the approval of vehicles intended for the carriage of dangerous goods with regard to their specific construction features
106	Uniform provisions concerning the approval of pneumatic Tires for agricultural vehicles and their trailers
107	Uniform provisions concerning the approval of category M_2 and M_3 vehicles with regard to their general construction
108	Uniform provisions concerning the approval for the production of retreated pneumatic Tires for motor vehicles and their trailers
109	Uniform provisions concerning the approval for the production of retreated pneumatic Tires for commercial vehicles and their trailers

UN Regulation	Title
110	Uniform provisions concerning the approval of: I. Specific components of motor vehicles using compressed natural gas (CNG) and/or liquefied natural gas (LNG) in their propulsion system II. Vehicles with regard to the installation of specific components of an approved type for the use of compressed natural gas (CNG) and/or liquefied natural gas (LNG) in their propulsion system
111	Uniform provisions concerning the approval of tank vehicles of categories N and O with regard to rollover stability
112	Uniform provisions concerning the approval of motor vehicle headlamps emitting an asymmetrical passing-beam or a driving-beam or both and equipped with filament lamps and/or Light-Emitting Diode (LED) modules
113	Uniform provisions concerning the approval of motor vehicle headlamps emitting a symmetrical passing-beam or a driving-beam or both and equipped with filament, gas-discharge light sources or LED modules
114	Uniform provisions concerning the approval of: I. An airbag module for a replacement airbag system; II. A replacement steering wheel equipped with an airbag module of an approved type; III. A replacement airbag system other than that installed in a steering wheel
115	Uniform provisions concerning the approval of: I. Specific LPG (liquefied petroleum gases) retrofit systems to be installed in motor vehicles for the use of LPG in their propulsion system; II. Specific CNG (compressed natural gas) retrofit systems to be installed in motor vehicles for the use of CNG in their propulsion system
116	Uniform technical prescriptions concerning the protection of motor vehicles against unauthorized use
117	Uniform provisions concerning the approval of Tires with regard to rolling sound emissions and/or adhesion on wet surfaces and/or rolling resistance
118	Uniform technical prescriptions concerning the burning behaviour and/or the capability to repel fuel or lubricant of materials used in the construction of certain categories of motor vehicles
119	Uniform provisions concerning the approval of cornering lamps for power-driven vehicles

UN Regulation	Title
120	Uniform provisions concerning the approval of internal combustion engines to be installed in agricultural and forestry tractors and in non-road mobile machinery, with regard to the measurement of the net power, net torque and specific fuel consumption
121	Uniform provisions concerning the approval of vehicles with regard to the location and identification of hand controls, tell-tales and indicators
122	Uniform technical prescriptions concerning the approval of vehicles of categories M, N and O with regard to their heating systems
123	Uniform provisions concerning the approval of Adaptive Front-lighting Systems (AFS) for motor vehicles
124	Uniform provisions concerning the approval of wheels for passenger cars and their trailers
125	Uniform provisions concerning the approval of motor vehicles with regard to the forward field of vision of the motor vehicle driver
126	Uniform provisions concerning the approval of partitioning systems to protect passengers against displaced luggage, supplied as non-original vehicle equipment
127	Uniform provisions concerning the approval of motor vehicles with regard to their pedestrian safety performance
128	Uniform provisions concerning the approval of light emitting diode (LED) light sources for use in approved lamp units on power-driven vehicles and their trailers
129	Uniform provisions concerning the approval of enhanced Child Restraint Systems used on board of motor vehicles (ECRS)
130	Uniform provisions concerning the approval of motor vehicles with regard to the Lane Departure Warning System (LDWS)
131	Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking Systems (AEBS)
132	Uniform provisions concerning the approval of Retrofit Emission Control Devices (REC) for heavy duty vehicles, agricultural and forestry tractors and non-road mobile machinery equipped with compression ignition engines
133	Uniform provisions concerning the approval of motor vehicles with regard to their reusability, recyclability and recoverability

UN Regulation	Title
134	Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of Hydrogen-Fuelled Vehicles (HFCV)
135	Uniform provisions concerning the approval of vehicles with regard to their Pole Side Impact performance (PSI)
136	Uniform provisions concerning the approval of vehicles of category L with regard to specific requirements for the electric power train
137	Uniform provisions concerning the approval of passenger cars in the event of a frontal collision with focus on the restraint system
138	Uniform provisions concerning the approval of Quiet Road Transport Vehicles with regard to their reduced audibility (QRTV)
139	Uniform provisions concerning the approval of passenger cars with regard to Brake Assist Systems (BAS)
140	Uniform provisions concerning the approval of passenger cars with regard to Electronic Stability Control (ESC) Systems
141	Uniform provisions concerning the approval of vehicles with regard to their Tire Pressure Monitoring Systems (TPMS)
142	Uniform provisions concerning the approval of motor vehicles with regard to the installation of their Tires
143	Uniform provisions concerning the approval of Heavy Duty Dual-Fuel Engine Retrofit Systems (HDDF-ERS) to be installed on heavy duty diesel engines and vehicles
144	Uniform provisions concerning the type approval of: Ia. Crash Emergency Call Components (AECC) Ib. Crash Emergency Call Devices (AECD) which are intended to be fitted to vehicles of categories M_1 and N_1 II. Vehicles with regard to their Crash Emergency Call Systems (AECS) when equipped with an AECD of an approved type III. Vehicles with regard to their Crash Emergency Call Systems (AECS)when equipped with an AECD of non-approved type
145	Uniform provisions concerning the approval of vehicles with regard to ISOFIX anchorage systems ISOFIX top tether anchorages and i-Size seating positions

UN Regulation	Title
146	Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles of categories L_1, L_2, L_3, L_4 and L_5
147	Uniform provisions concerning the approval of mechanical coupling components of combinations of agricultural vehicles

Schedule I-3. Main links concerning the 1958 Agreement

I. Agreement concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations (Revisión 3).

http://www.unece.org/trans/main/wp29/wp29regs.html

II. UN Regulations annexed to the 1958 Agreement:

http://www.unece.org/trans/main/wp29/wp29regs1-20.html
http://www.unece.org/trans/main/wp29/wp29regs21-40.html
http://www.unece.org/trans/main/wp29/wp29regs41-60.html
http://www.unece.org/trans/main/wp29/wp29regs61-80.html
http://www.unece.org/trans/main/wp29/wp29regs81-100.html
http://www.unece.org/trans/main/wp29/wp29regs101-120.html
http://www.unece.org/trans/main/wp29/wp29regs121-140.html
http://www.unece.org/trans/main/wp29/wp29regs141-160.html

III. Status of the 1958 Agreement, and of the annexed UN Regulations and of the Type Approval Authorities and Technical Services:

http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocstts.html

IV. World Forum for Harmonization of Vehicles Regulations (WP.29).

http://www.unece.org/trans/main/welcwp29.html

V. Terms of Reference (WP.29).

http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29tor.html

VI. World Forum for Harmonization of Vehicles Regulations (WP.29). How it works. How to join it (Third edition of 2012. A fourth edition is under development by the WP.29 secretariat).

http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29pub.html

VII. A new UNECE website template on Rev.3-IWVTA-DETA-UI-Guidelines is currently under development:

https://www.unece.org/index.php?id=45443

Schedule I.4. World Forum for Harmonization of Vehicles Regulations (WP.29)

I.4.1. Additional information about the WP29 World Forum

Procedure for government participation in World Forum meetings

The official process to become a participant is to simply send a letter signed by the authorized official of an interested country or REIO (regional economic integration organization) notifying the secretariat of WP.29 of the desire of that country or REIO to send representative(s) to the sessions and to participate in the activities of WP.29.

Procedure to accede to the 1958 Agreement

As this agreement is already in force, a country or a REIO may express its consent to be bound by the agreement by depositing an **instrument of accession** with the Secretary-General of the United Nations.

The instrument of accession must be:

a) Done by the Head of State, the Head of Government, or the Minister for Foreign Affairs of that country.

b) Done by a person in possession of a valid instrument of Full Powers signed by one of the afore-mentioned representatives of a country or REIO, indicating clearly the title of the Agreement and the name and function of the official authorized to sign.

The model of the instrument of accession which must be submitted to the UN Office of Legal Affairs (OLA) in New York is reproduced below. The instrument of accession is normally submitted by the Permanent Representation of the State to the UN. It is recommended to contact the corresponding service of the Ministry of Foreign Affairs, as it has the appropriate experience in these procedures regarding the Agreements that the country has signed.

Table A2. Model of an Instrument of Accession adapted to the peculiarities of the 1958 Agreement.

MODEL INSTRUMENT OF ACCESSION (Model adapted to the accession to Revision 3 of the 1958 Agreement) **(To be signed by the Head of State, Head of Government or Minister of Foreign Affairs or any person with full powers)** **It is recommended to contact the Ministry of Foreign Affairs**
ACCESION **WHEREAS** the [title of treaty, convention, agreement, etc.] was [concluded, adopted, opened for signature, etc.] at [place] on [date], **NOW THEREFORE**, I, [name and title of the Head of State, Head of Government or Minister of Foreign Affairs] declare that the Government of [name of State], having considered the above-mentioned [treaty, convention, agreement, etc.], accedes to the same and undertakes faithfully to perform and carry out the stipulations therein contained. *[In accordance with Article 1.5 of the Agreement, [name of State] declares that it is not bound by [none/list of UN Regulations]. This paragraph is optional.* *[In accordance with Article 11, [name of State] declares that it is not bound by article 10 of the Agreement]. This paragraph is optional.* **IN WITNESS WHEREOF,** I have signed this instrument of accession at [place] on [date]. [Signature]

The Organization of the WP.29 World Forum and its Subsidiary Bodies

The WP.29 World Forum is a permanent Working Party in the UNECE Inland Transport Committee. As stated before, it became the World Forum for Harmonization of Vehicle Regulations in 2000 (see the organization chart below in Table A3). Its role and that of its subsidiary Working Parties is to develop new UN Regulations (1958 Agreement), new UN Global Technical Regulations (1998 Agreement) and new UN Rules (1997 Agreement), to harmonize, amend and update existing UN Regulations in the areas of interest covered by the Agreements administered by the WP.29 World Forum.

The day-to-day WP.29 activities are managed by the ECE secretariat. The secretariat provides the administrative support for all sessions, including the preparation of the agendas, working documents, and reports. The work coordination of WP.29 is managed by a Steering Committee (WP.29/AC.2) comprised of the Chairperson, Vice-Chairperson and the Secretariat of the WP.29 World Forum, the Chair and Vice-Chair each of the Executive Committees of the three Agreements, the representatives of the European Community, Japan and the United States of America, and the Chairperson and Vice-Chairperson of each subsidiary Working Party of WP.29. The duties of WP.29/AC.2 are to develop and recommend a program of work to WP.29, review the reports and recommendations of the subsidiary Working Parties and identify items that require action by WP.29 and the time frame for their consideration, and provide recommendations to WP.29.

Meeting sessions of the WP.29 World Forum are held three times a year. The subsidiary Working Parties of experts hold two meetings a year. WP.29/AC.2 Committee meetings are held prior to each WP.29 session. The main areas of concern of the Working Parties are the following:

Active safety of vehicles and their parts (crash avoidance)

The UN Regulations seek to improve the behavior, handling and equipment of vehicles so as to decrease the possibility of a road crash. Some of the UN regulations seek to increase the driver's ability to detect and avoid hazards. Others seek to increase the driver's ability of to maintain control of the vehicle. Specific examples of current UN regulations include lighting and light-signaling devices, braking and running gear, including steering, Tires and rollover stability where the technology changes rapidly. The advent of advanced (e.g., electronic, computer, and communication) technologies is providing opportunities for seeking new remedies that can help drivers avoid crashes.

Passive safety of vehicles and their parts (crashworthiness)

The UN Regulations in this area seek to minimize the chance and severity of injury for the occupants of a vehicle and/or other road users in the event of a crash. Extensive use is made of crash statistics to identify safety problems for which a UN Regulation or amendment to an existing one is needed and define a proper cost/benefit approach when improving performance requirements in this area. This is important, given the overall impact of new requirements on vehicle construction, design and cost. Specific examples of current UN Regulations include ones addressing the ability of the vehicle structure to manage crash energy and resist intrusion into the passenger compartment, occupant restraint and protection systems for children and adults, seat structure, glazing, door latches and door retention, pedestrian protection and for motorcycles, the quality of the protective helmet for the rider. This area of technology also is changing rapidly and becoming more complex. Examples include advanced protection devices that adjust their performance in response to the circumstances of individual crashes. In addition, changes in the vehicle population are raising issues of vehicle compatibility and aggressivity.

Environmental considerations

Individual UN Regulations have been established to address the specific safety requirements for LPG (liquefied petroleum gas), CNG (natural compressed gas) and electric vehicles, including hybrid and plug-in electric hybrid vehicles

In addition to these new considerations, there are a considerable number of UN regulations that regulate and limit vehicle emissions of pollutants and noise. It is safe to say that emission limits for all types of vehicles have been significantly reduced in recent years.

General safety considerations

The UN Regulations in this area address vehicle and component features which are not directly linked to the above-mentioned subject areas. For example, windshield wipers and washers, controls and displays and glazing are grouped under this heading. Further, theft prevention and the considerations of public transport vehicles for which special expertise is needed in establishing their performance requirements are covered in this category.

Special technical considerations

In some cases, a specific problem needs to be solved urgently or needs to be addressed by persons having a special expertise. In such situations, a special informal working group may be entrusted with the analysis of the problem and invited to prepare a proposal for a UN Regulation. Although such cases have traditionally been kept to a minimum, the rapid development of complex new technologies is increasing the necessity for using this special approach. There are currently about 30 informal working groups

1.4-2. Additional considerations of the UN Regulations annexed to the Agreement

Procedures for granting type approvals in accordance with the UN Regulations annexed to the 1958 Agreement

Upon accession to the 1958 Agreement and in order to implement any new UN Regulations, the new Contracting Party shall designate a Type Approval Authority (TAA). The Parties to the Agreement usually designate the relevant national service in charge of the national approval of vehicles as their TAA.

When applying a UN Regulation, the TAA may designate one or more Technical Services (TS) to perform the regulatory tests included in the relevant UN Regulation. A Contracting Party may designate Technical Services of other countries.

The requirements for resolving interpretation issues and the requirements for Type Approval Authorities (TAA) and Technical Services (TS) under the 1958 Agreement are included in the Agreement, in Annexes 2 and 6 of the Administrative and Procedural Provisions.

After a manufacturer has applied for a Type Approval, the corresponding TAA will assess whether the manufacturer has an appropriate quality control system for production. In the absence of said quality control system, Type Approvals cannot be granted.

Only after verifying the existence of an adequate Quality Control System, the manufacturer may request any of the technical services designated for a specific UN Regulation to perform the mandatory UN Regulation tests. The required technical documentation, as indicated in each UN Regulation, must be submitted by the manufacturer or its legal representative.

The designated technical service will issue a technical report including the results of said tests. Only if the test results are in accordance with the provisions of the UN Regulation, the TAA can grant the corresponding Type Approval. The TAA will issue a Type Approval certificate, which will include a TAA number and a mandatory mark for the approved system or part. Models of Type Approval Certificates and examples of Type Approvals, their number and marks are included in each UN Regulation.

Annex 5 of the Administrative and Procedural Provisions defines how the UN Type Approval documentation circulates among the Contracting Parties. This can be done: by paper copies, by e-mail or by using the secure Internet database (DETA) established by the UNECE. All Contracting Parties applying a UN Regulation, and only them, shall have access to the information for that UN Regulation contained in the database.

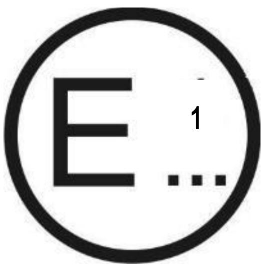
The TAA which has granted a Type Approval must take the appropriate measures to ensure Conformity of Production is carried out in accordance with the general provisions contained in Annex 1 of the Administrative and Procedural Provisions of the 1958 Agreement and the provisions in each specific UN Regulation.

If a Conformity of Production procedure reveals a non-conformity, the TAA shall allow the manufacturer time to rectify the non-conformity or request the manufacturer to update the Type Approval. After having considered the potential impact on vehicle safety or on the protection of the environment, the TAA may even **WITHDRAW the Approval**. This withdrawal shall be communicated to the other Contracting Parties applying the same UN Regulation, so that they can refuse the registration of that type of vehicle.

Schedule I-5. Example of the Type-Approval Certificate and the Approval Mark of UN Regulation No. 13-H on Brakes of M1 and N1 vehicles

Communication

(Maximum format: A4 (210 x 297 mm))



issued by: Name of administration:

....
....

Concerning: -Approval granted
-Approval extended
-Approval refused
-Approval withdrawn
-Production definitively discontinued of a vehicle type with regard to braking,
pursuant to UN Regulation No. 13-H

Approval No. Extension No. ....

1. Trade name or mark of the vehicle ....

2. Vehicle type ....

3. Manufacturer's name and address ....

4. If applicable, name and address of manufacturer's representative ....

5. Mass of vehicle ....

5.1. Maximum mass of vehicle ....

5.2. Minimum mass of vehicle ....

6. Distribution of mass of each axle (maximum value) ....

7. Make and type of brake linings, discs and drums: ....

7.1. Brake linings...

7.1.1. Brake linings tested to all relevant prescriptions of Annex 3 ....

7.1.2. Alternative brake linings tested in Annex 7 ....

7.2. Brake disc and drums...

7.2.1. Identification code of brake discs covered by the braking system approval ....

....

7.2.2. Identification code of brake drums covered by the braking system approval ....

....

8. Engine type ....

9. Number and ratios of gears ....

10. Final drive ratio(s) ....

11. If applicable, maximum mass of trailer which may be coupled ....

11.1. Unbraked trailer ....

12. Tire dimension ....

12.1. Temporary-use spare wheel / Tire dimensions ....

12.2. Vehicle meets the technical requirements of Annex 3 to UN Regulation No. 64: .... Yes/No[2]

13. Maximum design speed ....

14. Brief description of braking equipment ....

15. Mass of vehicle when tested:

	Laden (kg)	*Unladen (kg)*
Axle No. 1		
Axle No. 2		
Total		

16. Result of the tests:

Test Speed (km/h)	*Measured performance*	*Measured force applied to control (daN)*

16.1. Type-0 tests:..

Engine disconnected...

Service braking (laden) ....

Service braking (unladen) ....

Secondary braking (laden) ....

Secondary braking (unladen) ....

16.2. Type-0 tests:..

Engine connected ....

Service braking (laden) ....

Service braking (unladen) ....

(In accordance with paragraph 2.1.1.(B) of Annex 3).....................................

16.3. Type-I tests:...

Preliminary snubs (to determine pedal force)..

Hot performance (1st stop) ....

Hot performance (2nd stop) ....

Recovery performance ....

16.4. Dynamic parking brake performance ....

17. Result of the Annex 5 performance tests ....

18. Vehicle is / is not[2] equipped to tow a trailer with electrical braking systems..

19. Vehicle is / is not[2] equipped with an anti-lock system ....

19.1. The vehicle fulfils the requirements of Annex 6: Yes / No[2] ....

19.2. Category of anti-lock system: category 1 / 2 / 3[2]...

20. Adequate documentation according to Annex 8 was supplied in respect of the following system(s): .... Yes / No / Not applicable[2]

21. Vehicle submitted for approval on ....

22. Technical Service responsible for conducting approval ....

23. Date of report issued by that Service ....

24. Number of reports issued by that Service ....

25. Approval granted / refused / extended / withdrawn[2]

26. Position of approval mark on the vehicle ....

27. Place ....

28. Date...

29. Signature ....

30. The summary referred to in paragraph 4.3. of this Regulation is annexedto this communication

ANNEX 1. APPENDIX

List of Vehicle Data for the Purpose of UN Regulation No. 90 Approval

1. Description of the vehicle type ....

1.1. Trade name or mark of the vehicle, if available ....

1.2. Vehicle category ....

1.3. Vehicle type according to UN Regulation No. 13-H approval ....

1.4. Models or trade names of vehicles constituting the vehicle type, if available ....

1.5. Manufacturer's name and address ....

2. Make and type of brake linings, discs and drums: ....

2.1. Brake linings ....

2.1.1. Brake linings tested to all relevant prescriptions of Annex 3 ....

2.1.2. Alternative brake linings tested in Annex 7 ....

2.2. Brake disc and drums ....

2.2.1. Identification code of brake discs covered by the braking system approval ....

2.2.2. Identification code of brake drums covered by the braking system approval ....

3. Minimum mass of vehicle...

3.1. Distribution of mass of each axle (maximum value) ....

4. Maximum mass of vehicle ....

4.1. Distribution of mass of each axle (maximum value) ....

5. Maximum vehicle speed...

6. Tire and wheel dimensions...

7. Brake circuit configuration (e.g. front/rear or diagonal split)..

8. Declaration of which is the secondary braking system...

9. Specifications of brake valves (if applicable)...

9.1. Adjustment specifications of the load sensing valve ....

9.2. Setting of pressure valve ....

10. Designed brake force distribution...

11. Specification of brake ....

11.1. Disc brake type (e.g. number of pistons with diameter(s), ventilated or solid disc)...

11.2. Drum brake type (e.g. duo servo, with piston size and drum dimensions) ....

11.3. In case of compressed air brake systems, e.g. type and size of chambers, levers, etc. ....

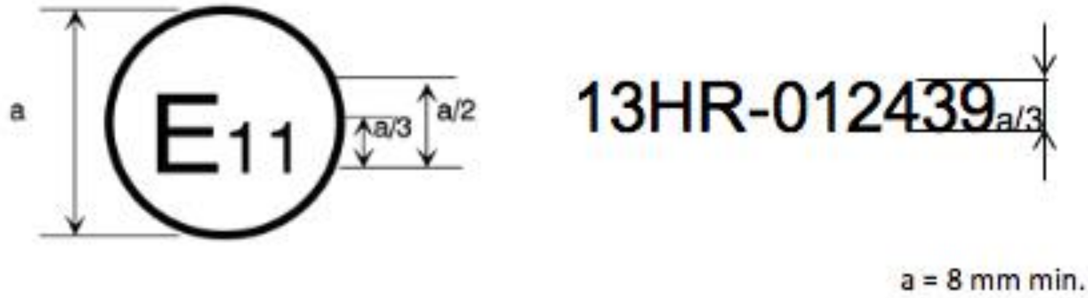
12. Master cylinder type and size...

13. Booster type and size ....

Arrangements of Approval Marks

MODEL A

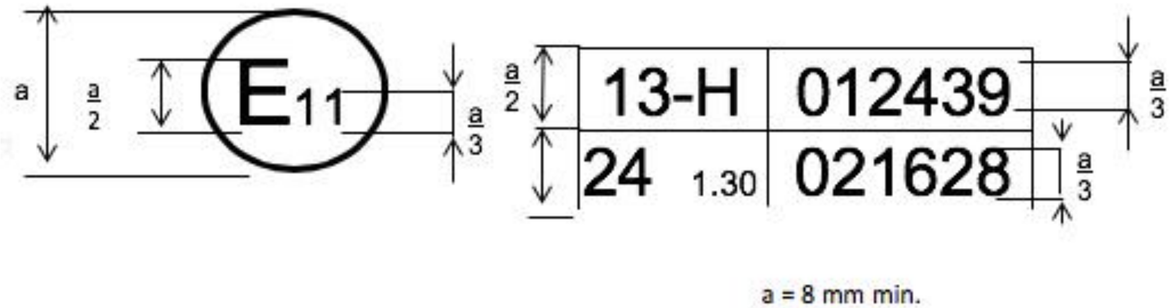
(See paragraph 4.4. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to braking, been approved in the United Kingdom (E11) pursuant to UN Regulation No. 13-H under approval number 012439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of the 01 series of amendments to UN Regulation No. 13-H.

MODEL B

(See paragraph 4.5. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the United Kingdom (E11) pursuant to Regulations Nos. 13-H and 24. (In the case of the latter Regulation the corrected absorption coefficient is 1.30 m^{-1}). The approval numbers indicate that, at the dates when the respective approvals were given, UN Regulation No. 13-H included the 01 series of amendments and UN Regulation No. 24 included the 02 series of amendments.

Schedule I-6. Requirements and examples of the UN Regulation approval marks included in this study

Point I-4.2 of these schedules reproduce the requirements of each and every one of the suggested UN Regulations concerning marks, its mandatory nature and its location, although the latter in a general way.

With regard to marks, there are two general cases:

Marks for parts: for example, safety belts, child restraint systems, etc. In these cases, the approval marks must be in each and every part.

Marks for systems and components: Such as the braking system, front impact protection, etc. The approval marks must be placed visibly and in an easily accessible place specified on the approval form **on each and every vehicle**. It should be noted that, despite this requirement stated in each UN Regulation, vehicles marketed in the EU do not have this mark. These vehicles marketed in the EU must have a whole vehicle type approval, which includes the type approval of more than 50 partial UN Regulations. To prove that they have a whole vehicle approval, they must have a manufacturer's plate indicating the whole vehicle approval. This ensures that it complies with all UN Regulations on components and systems. Notwithstanding this, **it is recommended that, for vehicles to be marketed in the LAC region, each and every vehicle should bear the type-approval mark for systems and components.**

UN Regulation No. 13-H (Braking of Passenger Cars)

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraphs 5. and 6. below, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved, its first two digits shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to the same vehicle type equipped with another type of braking equipment, or to another vehicle type.

4.3. Notice of approval or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation and of a summary of the information contained in the documents referred to in paragraphs 3.2.1. to 3.2.4. above, the drawings supplied by the applicant for approval being in a format of no more than A4 (210 x 297 mm), or folded to that format, and on an appropriate scale.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval[14] and of

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1. above.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations, annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. above, need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. above.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate.

4.8. Annex 2 to this Regulation gives examples of arrangements of approval marks.

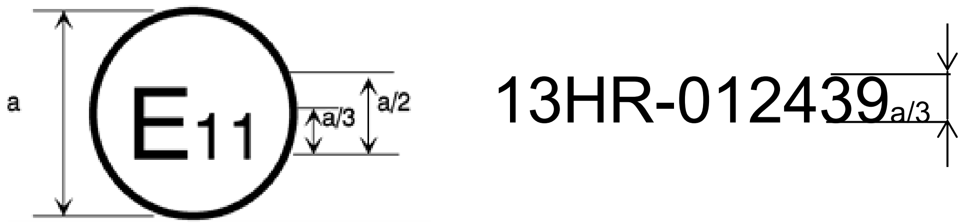
[14] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 6, Annex 3-www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

ANNEX 2

Arrangements of Approval Marks

MODEL A

(See paragraph 4.4. of this Regulation)

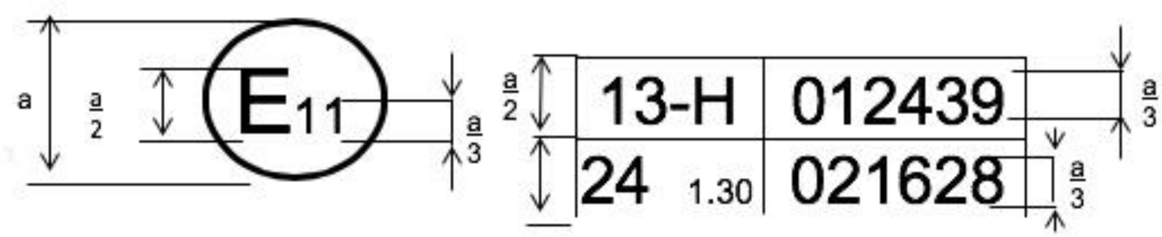


a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to braking, been approved in the United Kingdom (E11) pursuant to UN Regulation No. 13-H under approval number 012439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of the 01 series of amendments to UN Regulation No. 13-H.

MODEL B

(See paragraph 4.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the United Kingdom (E11) pursuant to Regulations Nos. 13-H and 24.[15](In the case of the latter Regulation the corrected absorption coefficient is 1.30 m^{-1}). The approval numbers indicate that,

---

15 This number is given merely as an example.

at the dates when the respective approvals were given, UN Regulation No. 13-H included the 01 series of amendments and UN Regulation No. 24 included the 02 series of amendments.

UN Regulation No. 14 (Safety-Belt Anchorages)

4. Approval

4.1. If the vehicle submitted for approval pursuant to this Regulation meets the relevant requirements of this Regulation, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 07, corresponding to the 07 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type as defined in paragraph 2.2. above.

4.3. Notice of approval or of extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to the Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval16;

4.4.2. The number of this Regulation, to the right of the circle prescribed in paragraph 4.4.1.

4.4.3. The letter "e", to the right of the number of this Regulation in the case of type approval according to the dynamic test of Annex 7.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations Annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case the additional numbers and symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.8. Annex 2 to this Regulation gives examples of arrangements of the approval mark.

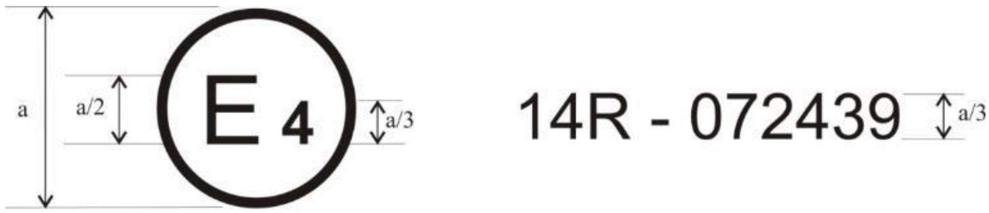
[16] The distinguish numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.2/Amend.1.

ANNEX 2

Arrangements of the Approval Mark

MODEL A

(See paragraph 4.4. of this Regulation)

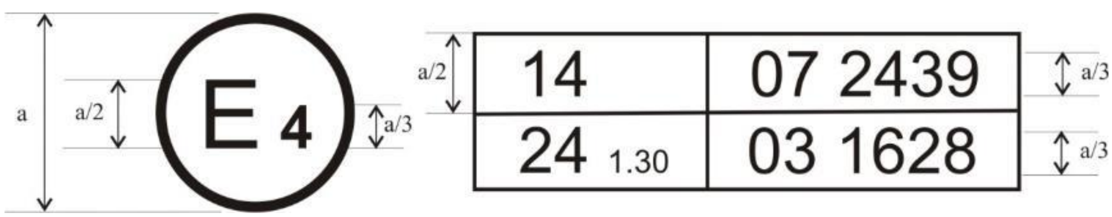


a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to safety-belt anchorages, been approved in the Netherlands (E 4), pursuant to Regulation No. 14, under the number 072439. The first two digits of the approval number indicate that Regulation No. 14 already included the 07 series of amendments when the approval was given.

MODEL B

(See paragraph 4.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 14 and 24[17]. (In the case of the latter Regulation the corrected absorption co-efficient is 1.30 m^{-1}). The approval numbers indicate that on the dates on which these approvals were granted, Regulation No. 14 included the 07 series of amendments and Regulation No. 24 was in its 03 series of amendments.

[17] The second number is given merely as an example.

UN Regulation No. 16 (Safety-belts)

4. Markings

The samples of a belt type or type of restraint system submitted for approval in conformity with the provisions of paragraphs 3.2.2.2., 3.2.2.3. and 3.2.2.4. above shall be clearly and indelibly marked with the manufacturer's name, initials or trade name or mark.

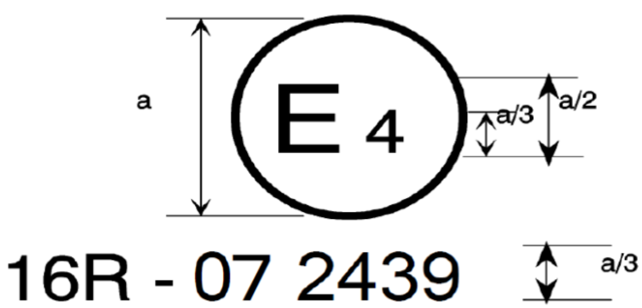
ANNEX 2

Arrangements of the Approval Marks

1. Arrangements of the vehicle approval marks concerning the installation of safety-belts.

MODEL A

(See paragraph 5.2.4. of this Regulation)

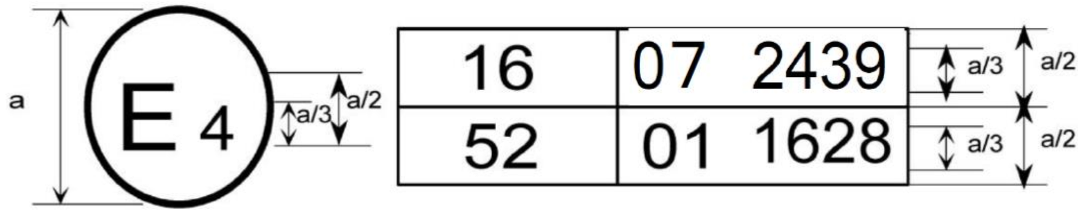


a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to safety-belts, been approved in the Netherlands (E4) pursuant to UN Regulation No. 16. The approval number indicates that the approval was granted according to the requirements of UN Regulation No. 16 as amended by the 07 series of amendments.

MODEL B

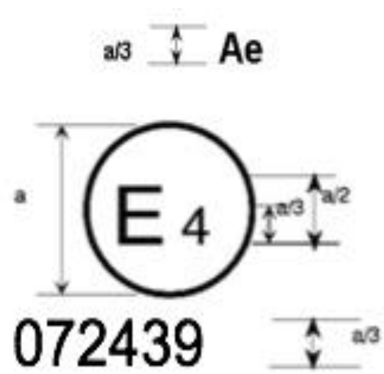
(See paragraph 5.2.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) pursuant to UN Regulations Nos. 16 and 52[18]F The approval numbers indicate that, at the dates when the respective approvals were given, UN Regulation No. 16 included the 07 series of amendments and UN Regulation No. 52 the 01 series of amendments.

2. Arrangements of the safety-belt approval marks (see paragraph 5.3.5. of this Regulation).



a = 8 mm min.

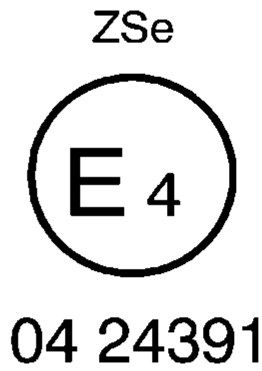
The belt bearing the above approval mark is a three-point belt ("A"), fitted with an energy absorber ("e") and approved in the Netherlands (E4) under the number 072439, thisRegulation already incorporating the 07 series of amendments at the time of approval.

[18] The second number is given merely as an example.

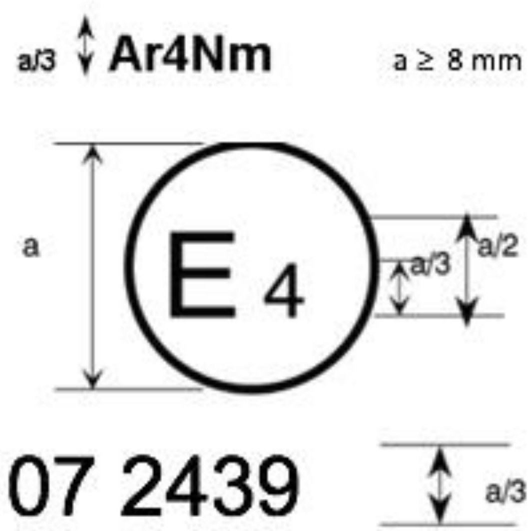
The belt bearing the above approval mark is a lap belt ("B"), fitted with a retractor, type 4, with multiple sensitivity (m) and approved in the Netherlands (E4) under the number 072489, thisRegulation already incorporating the 07series of amendments at the time of approval.

Note: The approval number and additional symbol(s) shall be placed close to the circle and either above or below the "E" or to left or right of that letter. The digits of the approval number shall be on the same side of the "E" and orientated in the same direction. The additional symbol(s) shall be diametrically opposite the approval number. The use of roman numerals as approval numbers should be avoided so as to prevent any confusion with other symbols.

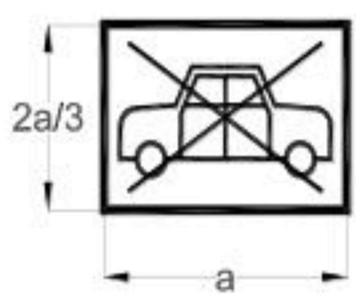
The belt bearing the above approval mark is a special type belt ("S"), fitted with an energy absorber ("e") and approved in the Netherlands (E4) under the number 0722439, this Regulation already incorporating the 07 series of amendments at the time of approval.



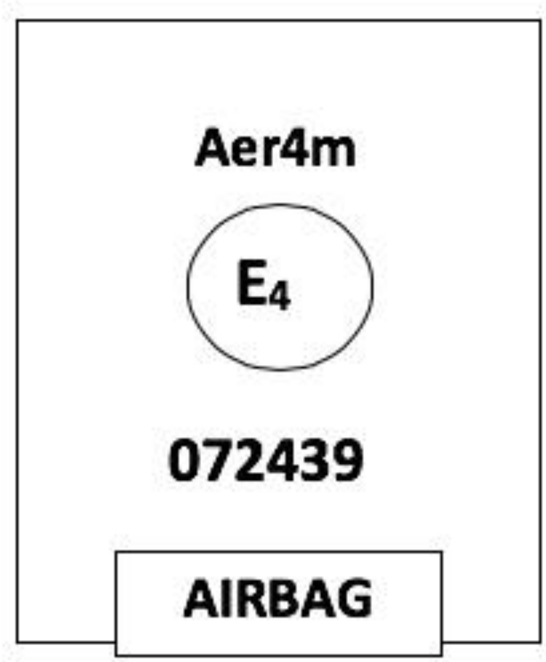
The belt bearing the above approval mark is part of a restraint system ("Z"), it is a special type belt ("S") fitted with an energy absorber ("e"). It has been approved in the Netherlands (E4) under the number 0724391, this Regulation already incorporating the 07 series of amendments at the time of approval.



a = 8 mm min.



The belt bearing this type approval mark is a three-point belt ("A") with a multiple-sensitivity ("m") type 4N ("r4N") retractor, in respect of which type approval was granted in the Netherlands ("E4") under number 072439, this Regulation already incorporating the 07 series of amendments at the time of approval. This belt shall not be fitted to vehicles of category M_1.



The safety-belt bearing this type approval mark is a three-point belt ("A") fitted with an energy absorber ("e"), approved as meeting the specific requirements of paragraph 6.4.1.3.3. or 6.4.1.3.4. of this Regulation, and with a multiple-sensitivity ("m") type 4 ("r4") retractor, in respect of which type approval was granted in the Netherlands ("E 4") under the approval number 072439. The first two digits indicate that this Regulation already incorporated the 07 series of amendments at the time of the approval. This safety-belt has to be fitted to a vehicle equipped with an airbag in the given seating position.

UN Regulation No. 17 (Strength of Seats, their Anchorages and Head Restraints)

4. Approval

4.1. If the vehicle submitted for approval pursuant to this Regulation meets the relevant requirements (seats fitted with head restraints or capable of being fitted with head restraints), approval of the vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 08, corresponding to the 08 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number either to the same vehicle type equipped with other types of seats or head restraints or with seats anchored differently on the vehicle (this applies both to seats with and to those without head restraints) or to another vehicle type.

4.3. Notice of approval or extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval; 19

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number, to the right of the circle prescribed in paragraph 4.4.1. above.

4.4.3. However, if the vehicle is equipped with one or more seats fitted or capable of being fitted with head restraints, approved as meeting the requirements under paragraphs 5.1. and 5.2. below, the number of this Regulation shall be followed by the letters "RA". The form conforming to the model in Annex 1 to this Regulation shall indicate which seat(s) of the vehicle is (are) fitted or capable of being fitted with head restraints. The marking shall also indicate that any remaining seats in the vehicle, not fitted or capable of being fitted with head restraints, are approved and meet the requirements of paragraph 5.1. below of this Regulation.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. above need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. above.

4.6. The approval mark shall be clearly legible and be indelible.

[19] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 3, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.8. Examples of arrangements of approval marks are given in Annex 2 to this Regulation.

ANNEX 2

Arrangements of the Approval Mark

MODEL A

(see paragraphs 4.4., 4.4.1., 4.4.2. and 4.4.3. of this Regulation)

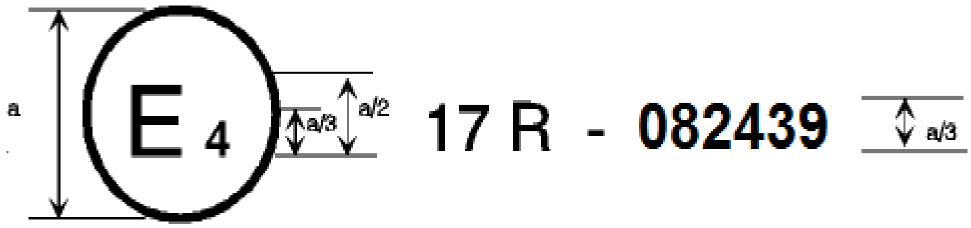
a = 8 mm min.

The above approval mark when affixed to a vehicle shows that the vehicle type concerned, with regard to the strength of the seats fitted or capable of being fitted with head restraints and with regard to characteristics of the head restraints, has been approved in the Netherlands (E 4) pursuant to Regulation No. 17, under the approval number 082439. The first two digits of the approval number indicate that the Regulation already contained the 08 series of amendments at the time of approval. The above approval mark also shows that the vehicle type was approved pursuant to Regulation No. 17 with regard to the strength of any seats on the vehicle which are not fitted or capable of being fitted with head restraints.

MODEL B

(See paragraphs 4.4.; 4.4.1. and 4.4.2. of this Regulation)

Vehicle with seats not fitted or not capable of being fitted with head restraints



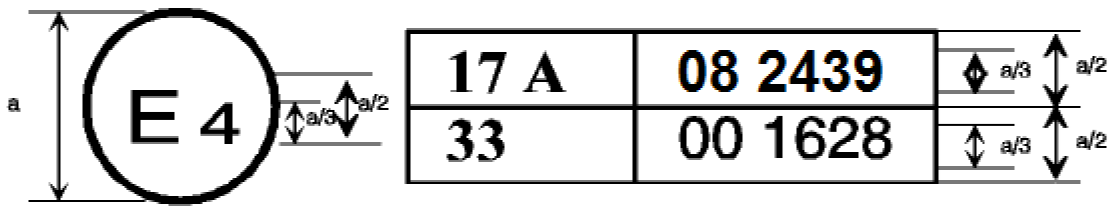
a = 8 mm min.

The above approval mark when affixed to a vehicle shows that the vehicle type has seats not fitted or capable of being fitted with head restraints, and has, with regard to the strength of the seats and their anchorages, been approved in the Netherlands (E 4) pursuant to Regulation No. 17 under the approval number 082439. The first two digits of the approval number indicate that the Regulation already contained the 08 series of amendments at the time of approval.

MODEL C

(see paragraphs 4.5. of this Regulation)

Vehicle with at least one seat fitted or capable of being fitted with a head restraint



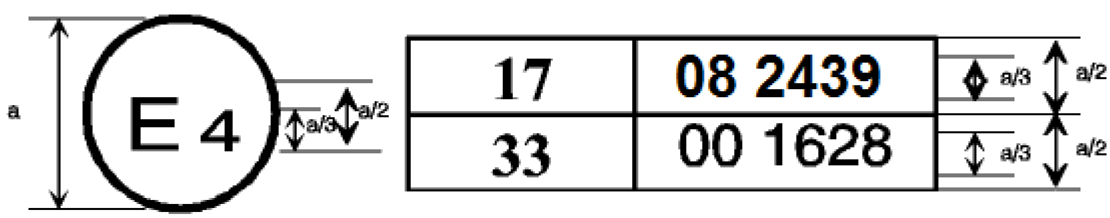
a = 8 mm min.

The above approval mark when affixed to a vehicle shows that the vehicle type has at least one seat fitted or capable of being fitted with a head restraint and was approved in the Netherlands (E 4) pursuant to Regulations Nos. 17 and 33.[20]

The approval numbers indicate that, on the dates when approval was granted, Regulation No. 17 included the 08 series of amendments, but Regulation No. 33 was still in its original form. The above approval mark also shows that the vehicle type was approved pursuant to Regulation No. 17 with regard to the strength of any seats on the vehicle which are not fitted or capable of being fitted with head restraints.

MODEL D

(see paragraphs 4.5. of this Regulation)



a = 8 mm min.

The above approval mark when affixed to a vehicle shows that the vehicle type has seats not fitted or capable of being fitted with head restraints and was approved in the Netherlands (E 4) pursuant to Regulations Nos. 17 and 33.[1] The approval numbers indicate that, on the dates when approval was

[20] The second number is given merely as an example.

granted, Regulation No. 17 included the 08 series of amendments, but Regulation No. 33 was still in its original form.

Regulation No. 25 (Head Restraints (Headrests))

4. MARKINGS

4.1. The devices submitted for approval shall:

4.1.1. Be clearly and indelibly marked with the trade name or mark of the applicant for approval;

4.1.2. Provide, at a site shown in the drawings referred to in paragraphs 3.2.2.3 or 3.2.3.3 above, adequate space for the approval mark.

4.2. Where the head restraint is of the "integral" or "removable" type (see definitions in paragraphs 2.2.1 and 2.2.2), the markings referred to in paragraphs 4.1.1 and 4.1.2 above may be reproduced on labels situated at a site shown in the drawings referred to in paragraph 3.2.4. above.

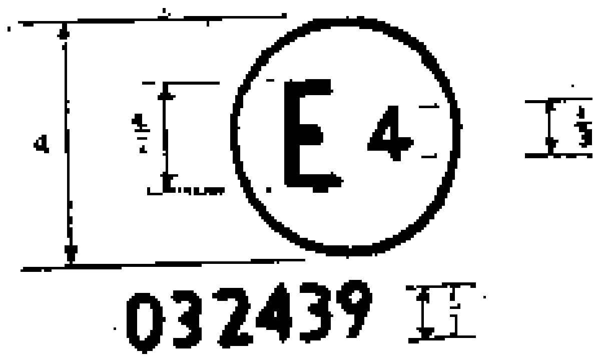
ANNEX 2

Arrangements of Approval Marks

1. Approval mark for an "integrated" or "removable" type head restraint (see the definitions in paragraphs 2.2.1 and 2.2.2 of this Regulation).

The above approval mark affixed to one or more "integrated" or "removable" type head restraints shows that, pursuant to Regulation No./25, the type of head restraint has been approved in the Netherlands (E4) under approval number 032439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No./25 as amended by the 03 series of amendments.

2. Approval mark for a "separate" type head restraint (see the definition in paragraph/2.2.3 of this Regulation).



The above approval mark affixed to a head restraint shows that the head restraint in question has been approved and that it is a "separate" head restraint, approved in the Netherlands (E4), under approval number/032439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No./25, as amended by the 03 series of amendments.

The approval number must be placed close to the circle and either above or below the "E", or to the left or right of that letter.

4.4. There shall be affixed conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation

4.4.1. an internal approval mark consisting of:

4.4.1.1. a circle surrounding the letter “E” followed by the distinguishing number of the country which has granted the approval; and

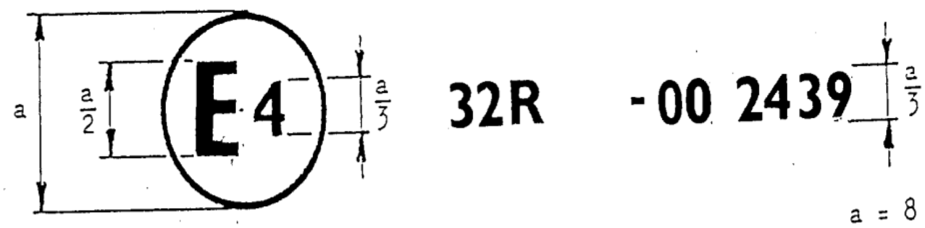
4.4.1.2. The number of this Regulation, followed by the letter “R”, a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.1.

Annex 2

ARRANGEMENTS OF APPROVAL MARKS

Model A

(See paragraph 4.4 of this Regulation)

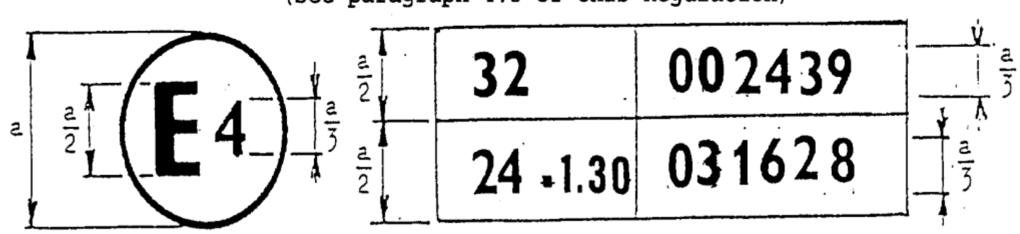


a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has with regard to the behaviour of the structure of the passenger compartment in a rear-end collision, been approved in the Netherlands (E 4), under the number 032439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 32 in its original form.

Model B

(See paragraph 4.5 of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 32 and 24. 1/ (In the case of the latter Regulation the corrected absorption co-efficient is 1.30 m^{-1}). The approval numbers indicate that on the dates on which these approvals were granted Regulation No. 32 had not yet been modified and Regulation No. 24 already included the 03 series of amendments.

1/ The second number is given merely as an example.

UN Regulation No. 44 (Child Restraint Systems)

4. Markings

4.1. The samples of child restraint submitted for approval in conformity with the provisions of paragraphs 3.2.2. and 3.2.3. above shall be clearly and indelibly marked with the manufacturer's name, initials or trade mark.

4.2. One of the parts made of plastics of the child restraint device (such as shell, impact shield, booster cushion, etc.), except the belt(s) or harness, shall be marked clearly (and indelibly) with the year of production.

4.3. If the restraint is to be used in combination with an adult safety belt the correct routing of the webbing shall be clearly indicated by means of a drawing permanently attached to the restraint. If the restraint is held in place by the adult safety-belt, the routes of the webbing shall be clearly marked on the product by colour coding. The colours for the safety-belt route to be used when the device is installed forward facing shall be red and when installed rear-facing shall be blue. The same colours shall also be used on the labels on the device that illustrate the methods of use.

There shall be a clear differentiation between the intended routes for the lap section and the diagonal section of the safety belt. Indication such as colour coding, words, shapes etc. shall distinguish each section of the safety belt.

In any illustration of the belt route on the product, the orientation of the child restraint relative to the vehicle shall be clearly indicated. Belt route diagrams that do not show the vehicle seat are not acceptable.

The marking defined in this paragraph shall be visible with the restraint in the vehicle. For group 0 restraints, this marking shall also be visible with the child in the restraint.

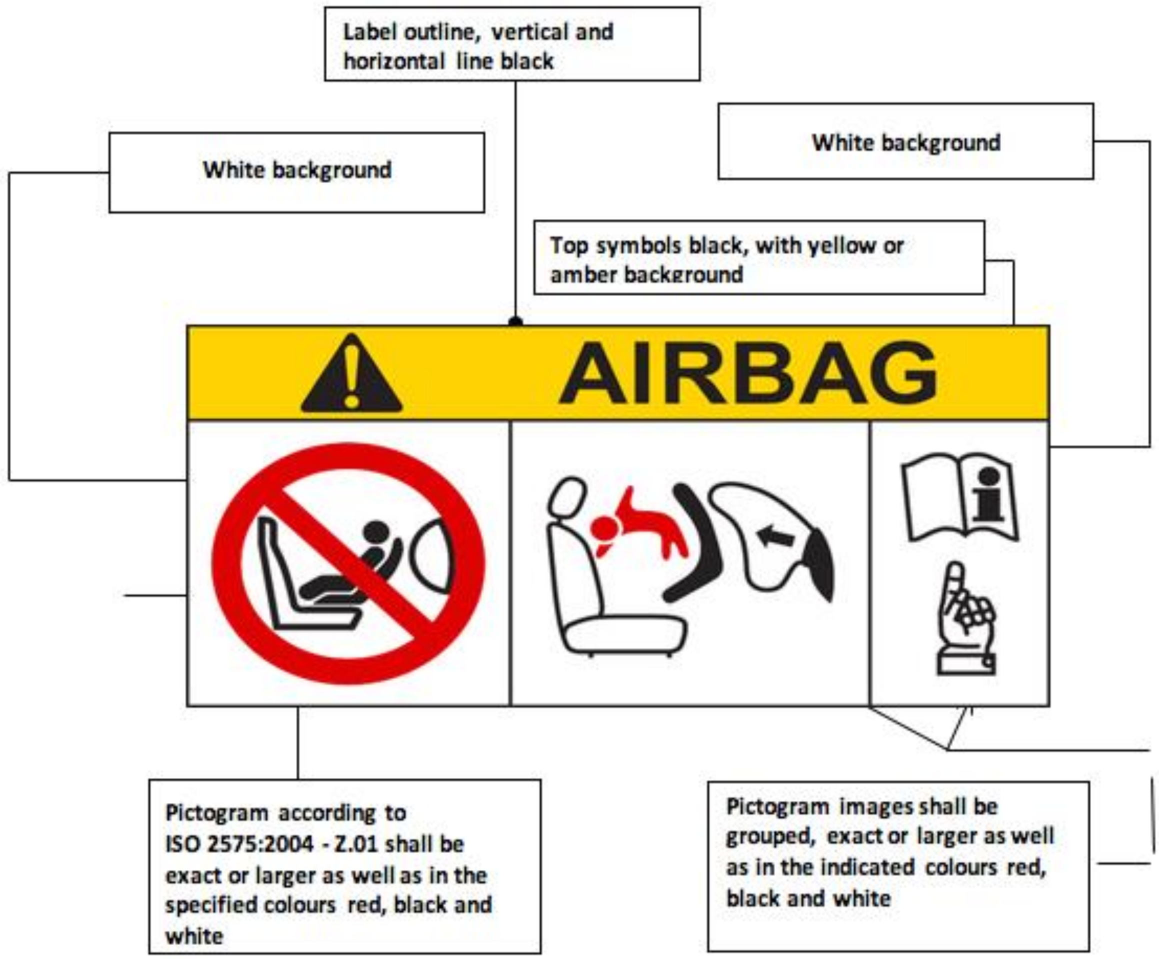
4.4. On the visible inner surface (including the side wing beside the child's head) in the approximate area where the child's head rests within the child restraint system, rearward facing restraints shall have the following label permanently attached (the information shown is a minimum).

Label minimum size: 60 x 120 mm.

The label shall be stitched to the cover around its entire perimeter and/or permanently bonded to the cover over its entire back surface. Any other form of attachment that is permanent and not liable to removal from the product or to becoming obscured is acceptable. Flag type labels are specifically prohibited.

If sections of the restraint or any accessories supplied by the child restraint system manufacturer are able to obscure the label an additional label is required. One warning label shall be permanently visible in all situations when the restraint is prepared for use in any configuration.

Figura A1. Illustration of the Belt Route



4.5. In the case of child restraints that can be used forward and rear-facing, include the words:

"IMPORTANT - DO NOT USE FORWARD FACING BEFORE THE CHILD'S WEIGHT EXCEEDS. (Refer to instructions)".

4.6. In the case of child restraints with alternative belt routes, the alternative load bearing contact points between the child restraint and the adult safety-belt shall be permanently marked. This marking shall indicate that it is the alternative belt route and shall conform with the above coding requirements for forward and rearward facing seats.

4.7. If the child restraint offers alternative load bearing contact points, the marking required in paragraph 4.3. shall include an indication that the alternative belt route is described in the instructions.

4.8. ISOFIX marking

If the product includes ISOFIX attachments, the following information shall be permanently visible to someone installing the restraint in a vehicle:

The ISO ISOFIX logo followed by the letter(s) that is/are appropriate for the ISOFIX size class(es) into which the product fits. As a minimum, a symbol consisting of a circle with a diameter of minimum 13 mm and containing a pictogram, the pictogram shall contrast with the background of the circle. The pictogram shall be clearly visible either by means of contrast colors or by adequate relief if it is molded or embossed.

Figura A2. The ISOFIX logo for size class into which the product fits

B, C and F

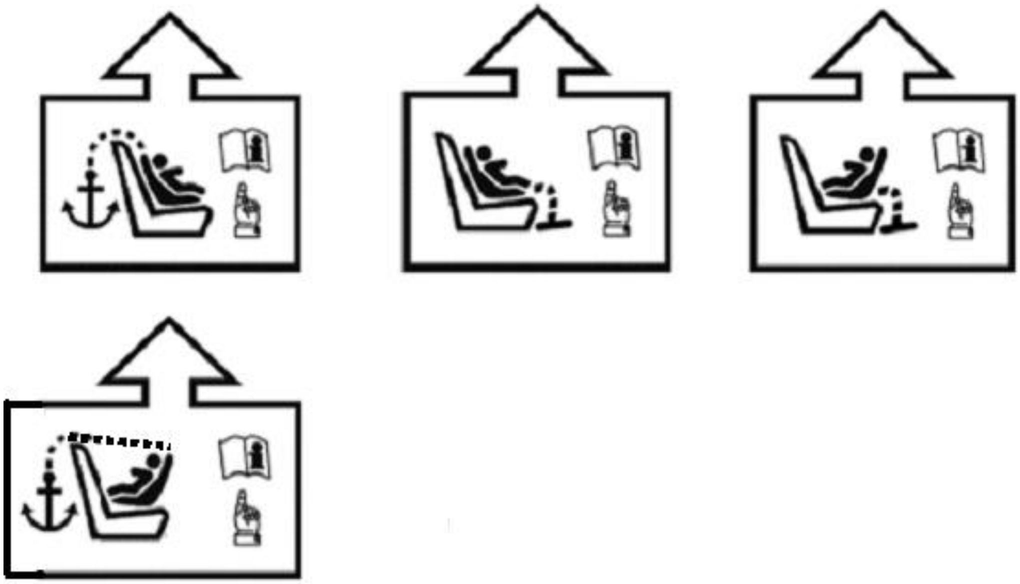
The following information may be conveyed by pictograms and/or text. The marking shall indicate:

a) The essential relevant steps needed for making the seat ready for installation. For example, the method of extending the ISOFIX latch system shall be explained;

b) The position, function, and interpretation of any indicator shall be explained;

c) The position and if necessary the routing of top tethers, or other means of limiting seat rotation requiring action by the user, shall be indicated using one of the following symbols as appropriate;

FigureA3. The essential relevant steps needed for making the seat ready for installation by pictograms

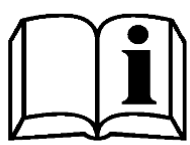


d) The adjustment of ISOFIX latches and the top tether, or other means of limiting seat rotation, requiring action of the user shall be indicated;

e) The marking shall be permanently attached and be visible to a user installing the seat;

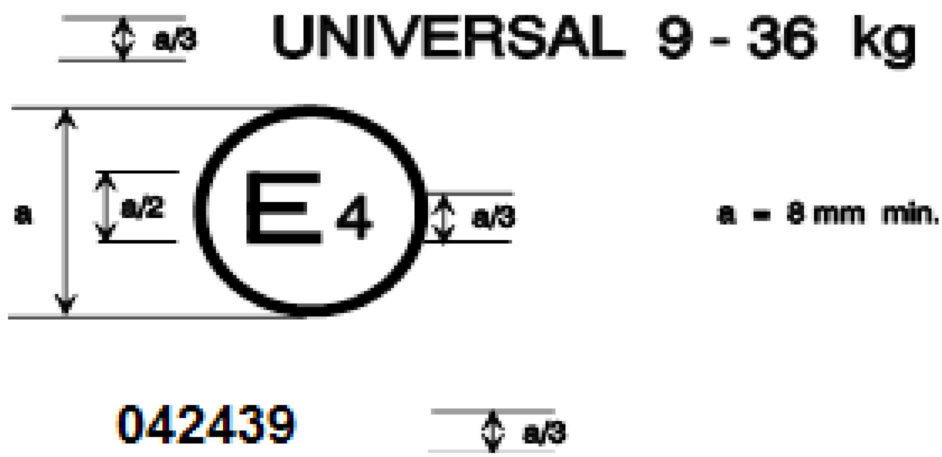
f) Where necessary reference should be made to the child restraint user instructions and to the location of that document using the symbol below.

Figure A4. **Symbol to the Child Restraint User Instructions**

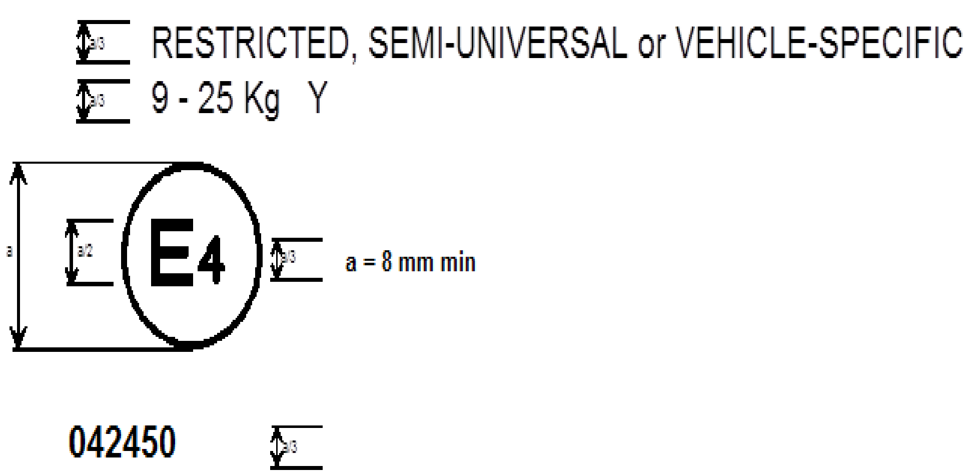


ANNEX 2

Arrangements of the Approval Marks



The child restraint system bearing the above approval mark is a device capable of being fitted in any vehicle and of being used for the 9 kg-36 kg mass range (Groups I to III); it is approved in the Netherlands (E 4) under the number 042439. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of restraining devices for child occupants of power-driven vehicles ("child restraint system") as amended by the 04 series of amendments.



The child restraint system bearing the above approval mark is a device not capable of being fitted in every vehicle and of being used for the 9 kg-25 kg mass range (Groups I and II); it is approved in the Netherlands (E 4) under the number 042450. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of restraining devices for child occupants of power-driven vehicles ("child restraint system") as amended by the 04 series of amendments. The symbol "Y" indicates that the system contains a crotch strap.

Note: The approval number and additional symbol(s) shall be placed close to the circle and either above or below the "E" or to left or right of it. The digits of the approval number shall be on the same side of the "E" and oriented in the same direction. The additional symbol(s) shall be diametrically opposite the approval number. The use of Roman numerals as approval numbers should be avoided so as to prevent any confusion with other symbols.

UN Regulation No. 83 (Emissions of M_1 and N_1 Vehicles)

4. Approval

4.1. If the vehicle type submitted for approval following this amendment meets the requirements of paragraph 5. of this Regulation, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved.

Its first two digits shall indicate the series of amendments according to which the approval was granted. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 2 to this Regulation.

4.3.1. In the event of amendment to the present text, for example, if new limit values are prescribed, the Contracting Parties to the Agreement shall be informed which vehicle types already approved comply with the new provisions.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country that has granted approval.21

[21] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.3–Annex 3,

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle described in paragraph 4.4.1.

4.4.3. The approval mark shall contain an additional character after the type approval number, the purpose of which is to distinguish vehicle category and class for which the approval has been granted. This letter should be chosen according to the Table A3/1 of Annex 3 to this Regulation.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case, the Regulation, approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. of this Regulation.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate.

4.7.1. Annex 3 to this Regulation gives examples of arrangements of the approval mark.

4.8. Additional requirements for vehicles fuelled by LPG or NG/biomethane

4.8.1. The additional requirements for vehicles fuelled by LPG or NG/biomethane are provided in Annex 12 to this Regulation.

4.9. Additional requirements for approval of flex fuel vehicles

4.9.1. For the type approval of a flex fuel ethanol or biodiesel vehicle, the vehicle manufacturer shall describe the capability of the vehicle to adapt to any mixture of petrol and ethanol fuel (up to an 85 per cent ethanol blend) or diesel and biodiesel that may occur across the market.

4.9.2. For flex fuel vehicles, the transition from one reference fuel to another between the tests shall take place without manual adjustment of the engine settings.

4.10. Requirements for approval regarding the OBD system

4.10.1. The manufacturer shall ensure that all vehicles are equipped with an OBD system.

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www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html.

4.10.2. The OBD system shall be designed, constructed and installed on a vehicle so as to enable it to identify types of deterioration or malfunction over the entire life of the vehicle.

4.10.3. The OBD system shall comply with the requirements of this Regulation during conditions of normal use.

4.10.4. When tested with a defective component in accordance with Appendix 1 to Annex 11 to this Regulation, the OBD system malfunction indicator shall be activated. The OBD system malfunction indicator may also activate during this test at levels of emissions below the OBD threshold limits specified in Annex 11 to this Regulation.

4.10.5. The manufacturer shall ensure that the OBD system complies with the requirements for in-use performance set out in paragraph 7. of Appendix 1 to Annex 11 to this Regulation under all reasonably foreseeable driving conditions.

4.10.6. In-use performance related data to be stored and reported by a vehicle's OBD system according to the provisions of paragraph 7.6. of Appendix 1 to Annex 11 to this Regulation shall be made readily available by the manufacturer to national authorities and independent operators without any encryption.

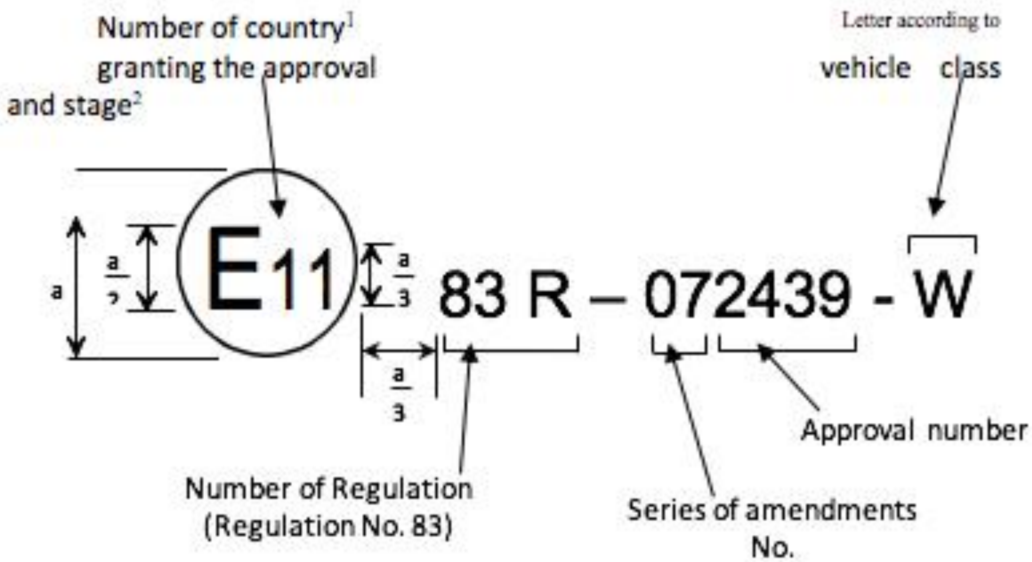
ANNEX 3

Arrangements of the Approval Mark

In the approval mark issued and affixed to a vehicle in conformity with paragraph 4. of this Regulation, the type approval number shall be accompanied by an alphabetical character assigned according to Table A3/1 of this annex, reflecting the vehicle category and class that the approval is limited to.

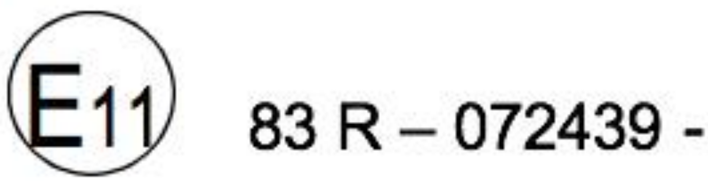
This annex outlines the appearance of this mark and gives an example how it shall be composed.

The following schematic graph presents the general lay-out, proportions and contents of the marking. The meaning of numbers and alphabetical character are identified, and sources to determine the corresponding alternatives for each approval case are also referred.



a = 8 mm (minimum)

The following graph is a practical example of how the marking should be composed.



The preceding approval mark affixed to a vehicle in conformity with paragraph 4. of this Regulation shows that the vehicle type concerned has been approved in the United Kingdom (E 11), pursuant to Regulation No. 83 under approval number 2439. This mark indicates that the approval was given in accordance with the requirements of this Regulation with the 07 series of amendments incorporated. Furthermore, the accompanying letter (X) denotes that the vehicle belongs to vehicle category N_1 Class II that meets the emission and OBD standards listed in Table.

Cuadro A3. Character with reference to fuel, engine and vehicle category

Character	*Vehicle category and class*	*Engine type*	*Emission standard*	*OBD standard*
T	M, N_1 Class I	CI	A	Interim OBD threshold limits (see Table A11/3)
U	N_1 Class II	CI	A	Interim OBD threshold limits (see Table A11/3)
V	N_1 Class III, N_2	CI	A	Interim OBD threshold limits (see Table A11/3)

W	M, N_1 Class I.	PI CI	A	Preliminary OBD threshold limits (see Table A11/2)
X	N_1 Class II	PI CI	A	Preliminary OBD threshold limits (see Table A11/2)
Y	N_1 Class III, N_2	PI CI	A	Preliminary OBD threshold limits (see Table A11/2)
ZA	M, N_1 Class I	PI CI	B	Preliminary OBD threshold limits (see Table A11/2)
ZB	N_1 Class II	PI CI	B	Preliminary OBD threshold limits (see Table A11/2)
ZC	N_1 Class III, N_2	PI CI	B	Preliminary OBD threshold limits (see Table A11/2)
ZD	M, N_1 Class I	PI CI	B	Final OBD threshold limits (see Table A11/1)
ZE	N_1 Class II	PI CI	B	Final OBD threshold limits (see Table A11/1)
ZF	N_1 Class III, N_2	PI CI	B	Final OBD threshold limits (see Table A11/1)

Emissions standard key

A Emission requirements according to the limits in Table 1 of paragraph 5.3.1.4. of this Regulation, but allowing the preliminary values for particulate numbers for PI vehicles as detailed in footnote 2 to that table;

B Emission requirements according to the limits in Table 1 of paragraph 5.3.1.4. of this Regulation, including the final particulate number standards for PI vehicles and use of E10 and B7 reference fuel (where applicable).

UN Regulation No. 94 (Frontal Collision Protection)

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of this Regulation, approval of that vehicle type shall be granted.

4.1.1. The Technical Service appointed in accordance with paragraph 12. below shall check whether the required conditions have been satisfied.

4.1.2. In case of doubt, account shall be taken, when verifying the conformity of the vehicle to the requirements of this Regulation, of any data or test results provided by the manufacturer which can be taken into consideration in validating the approval test carried out by the Technical Service.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 03 corresponding to the 03 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same approval number to another vehicle type.

4.3. Notice of approval or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated by the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation and photographs and/or diagrams and drawings supplied by the applicant for approval, in a format of no more than A4 (210 X 297 mm) or folded to that format and on an appropriate scale.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval22;

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number, to the right of the circle prescribed in paragraph 4.4.1. above.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. above need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

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[22] The distinguish numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to Consolidated Resolution on the Construction of Vehicles (R.E.3.), document TRANS/WP.29/78/Rev.6.

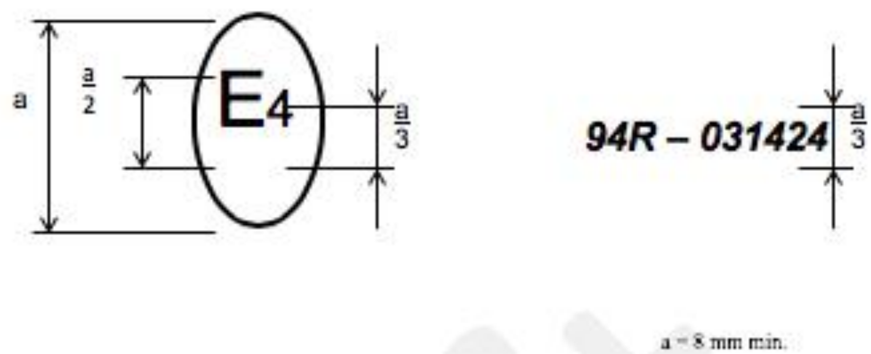
4.8. Annex 2 to this Regulation gives examples of approval marks.

ANNEX 2

Arrangements of Approval Marks

MODEL A

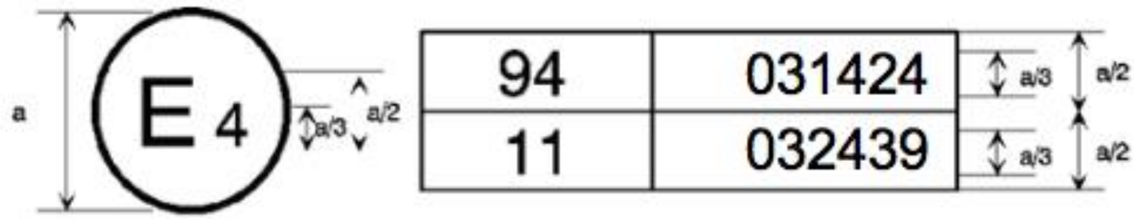
(See paragraph 4.4. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to the protection of the occupants in the event of a frontal collision, been approved in the Netherlands (E 4) pursuant to Regulation No. 94 under approval number 031424. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No. 94 as amended by the 03 series of amendments.

MODEL B

(See paragraph 4.5. of this Regulation)



The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No. 94 incorporated the 03 series of amendments and Regulation No. 11 incorporated the 03 series of amendments.

UN Regulation No. 95 (Lateral Collision Protection)

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraph 5. below, approval of that vehicle type shall be granted.

4.2. In case of doubt, account shall be taken, when verifying the conformity of the vehicle to the requirements of this Regulation, of any data or test results provided by the manufacturer which can be taken into consideration in validating the approval test carried out by the Technical Service.

4.3. An approval number shall be assigned to each type approved. Its first two digits (at present 03 corresponding to the 03 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same approval number to another vehicle type.

4.4. Notice of approval or of extension or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated by the Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1 to this Regulation and photographs and/or diagrams and drawings supplied by the applicant for approval, in a format of no more than A4 (210 x 297 mm) or folded to that format and on an appropriate scale.

4.5. There shall be affixed to every vehicle conforming to a vehicle type approved under this Regulation, conspicuously and in a readily accessible place specified on the approval form, an international approval mark consisting of:

4.5.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;23

4.5.2. The number of this Regulation, followed by the letter "R", a dash and the approval number, to the right of the circle prescribed in paragraph 4.5.1. above.

4.6. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.5.1. above need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.5.1. above.

4.7. The approval mark shall be clearly legible and shall be indelible.

4.8. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.9. Annex 2 to this Regulation gives examples of approval marks.

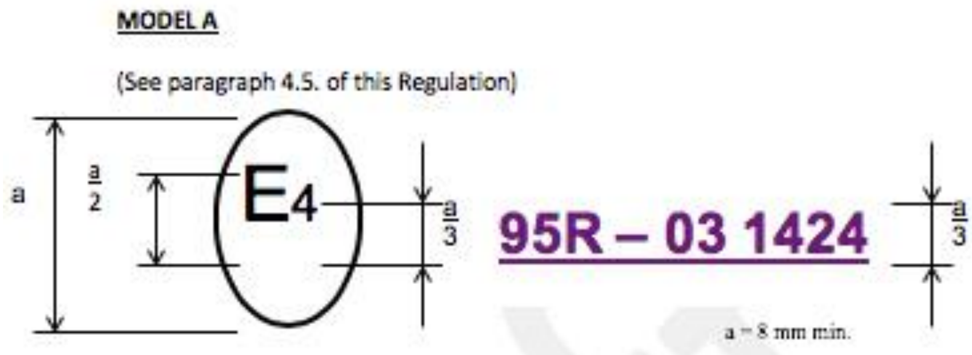
[23] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 3, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

ANNEX 2

Arrangements of the Approval Mark

MODEL A

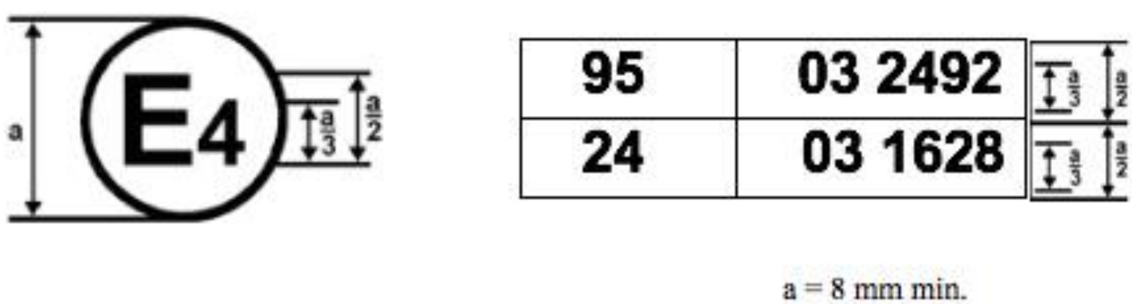
(See paragraph 4.5. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to the protection of the occupants in the event of a lateral collision, been approved in the Netherlands (E 4) pursuant to Regulation No. 95 under approval number 031424. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No. 95 as amended by the 03 series of amendments.

MODEL B

(See paragraph 4.6. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 95 and 24.[24] The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted. Regulation

[24] The latter number is given only as an example.

No. 95 incorporated the 03 series of amendments and Regulation No. 24 incorporated the 03 series of amendments.

UN Regulation No. 101 (CO_2 Emission/Fuel Consumption)

4. Approval

4.1. If the emissions of CO2 and fuel consumption and/or the electric energy consumption and electric range of the vehicle type submitted for approval pursuant to this Regulation have been measured according to the conditions specified in paragraph 5. below, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits shall indicate the series of amendments (at present 01) incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Contracting Parties to the 1958 Agreement applying this Regulation by means of a form conforming to the model in Annex 4 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval[25];

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1. above.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. above need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. above.

4.6. The approval mark shall be clearly legible and be indelible.

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25 The distinguish numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.2/Amend.3.

4.7. The approval mark shall be placed close to or on the vehicle data plate.

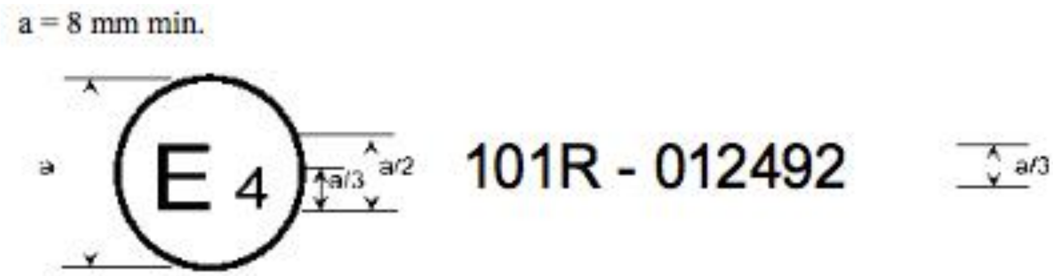
4.8. Annex 5 to this Regulation gives examples of arrangements of the approval mark.

ANNEX 5

Arrangements of Approval Marks

MODEL A

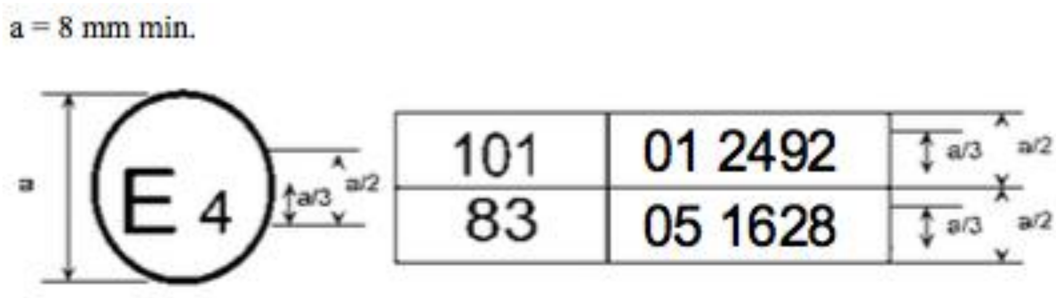
(See paragraph 4.4. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) with regard to the measurement of emissions of CO_2 and fuel consumption or to the measurement of electric energy consumption and electric range pursuant to Regulation No. 101 and under approval number 012492. The first two digits of the approval number indicate that the approval was granted according to the requirements of Regulation No. 101 as amended by the 01 series of amendments.

MODEL B

(See paragraph 4.5. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 101 and 83[26]. The first two digits of the approval numbers indicate that, at the dates when the respective approvals were given, Regulation No. 101 with the 01 series of amendments incorporated and Regulation No. 83 already included the 05 series of amendments.

UN Regulation No. 103 (Replacement Pollution Control Devices)

4. Approval

4.1. If the replacement pollution control device submitted for approval pursuant to this Regulation meets the requirements of paragraph 5. below, approval of that type of replacement pollution control device shall be granted.

4.2. Original replacement pollution control device, which indicated in Annex 2 of Regulation No. 831 and are intended for fitment to a vehicle to which the relevant type-approval document refers, do not need to be approved according to this Regulation provided they fulfill the requirements of paragraphs 4.2.1. and 4.2.2.

4.2.1. Marking

Original replacement pollution control devices shall bear at least the following identifications:

4.2.1.1. The vehicle manufacturer's name or trademark.

[26] The second number is given merely as an example.

4.2.1.2. The make and identifying part number of the original replacement pollution control device as recorded in the information mentioned in paragraph 4.2.3.

4.2.2. Documentation

Original replacement pollution control devices shall be accompanied by the following information:

4.2.2.1. The vehicle manufacturer's name or trademark.

4.2.2.2. Make and identifying part number of the original replacement pollution control device as recorded in the information mentioned in paragraph 4.2.3.

4.2.2.3. The vehicles for which the original replacement pollution control device is of a type indicated in Annex 2 of Regulation No. 832, including, where applicable, a marking to identify if the original replacement pollution control device is suitable for fitting to a vehicle that is equipped with an on-board diagnostic (OBD) system.

4.2.2.4. Installation instructions, where necessary.

4.2.2.5. This information shall be provided either:

a) As a leaflet accompanying the original replacement pollution control device, or

b) On the packaging in which the original replacement pollution control device is sold, or

c) By any other applicable means.

In any case, the information shall be available in the product catalogue distributed to points of sale by the vehicle manufacturer.

4.2.3. The vehicle manufacturer shall provide to the technical service and/or approval authority the necessary information in electronic format which makes the link between the relevant part numbers and the type approval documentation.

This information shall contain:

a) Make(s) and type(s) of vehicle,

b) Make(s) and type(s) of original replacement pollution control device,

c) Part number(s) of original replacement pollution control device,

d) Type-approval number of the relevant vehicle type(s).

4.3. An approval number shall be assigned to each replacement pollution control device type approved. Its first two digits (00 for the Regulation in its present form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another type of replacement pollution control device. The same approval number may cover the use of that replacement pollution control device type on a number of different vehicle types.

4.4. When the applicant for type-approval can demonstrate to the type-approval authority or technical service that the replacement pollution control device is of a type indicated in Annex 2 to the 05 or later series of amendments to Regulation No. 83, the granting of a type approval certificate shall not be dependent on the requirements specified in paragraph 5. having to be verified.

4.5. Notice of approval or of extension or of refusal of approval of a type of replacement pollution control device pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.

4.6. There shall be affixed, conspicuously and in a place specified on the approval form, to the replacement pollution control device conforming to a type of replacement pollution control device approved under this Regulation, an international approval mark consisting of:

4.6.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;27

4.6.2. The number of this Regulation, followed by the letter "R", a dash and the approval number in the vicinity of the circle prescribed in paragraph 4.4.1.

4.7. If the replacement pollution control device conforms to a pollution control device type approved under one or more other Regulations annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.8. The approval mark shall be indelible and clearly legible when the replacement pollution control device is mounted under the vehicle.

[27] The distinguish numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to Consolidated Resolution on the Construction of Vehicles (R.E.3), document TRANS/WP.29/78/Rev.2.

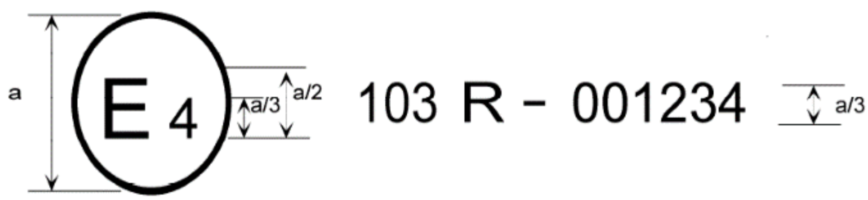
4.9. Annex 2 to this Regulation gives examples of arrangements of approval marks.

ANNEX 2

Examples of Arrangements of Approval Marks

MODEL A

(See paragraph 4.6. of this Regulation)

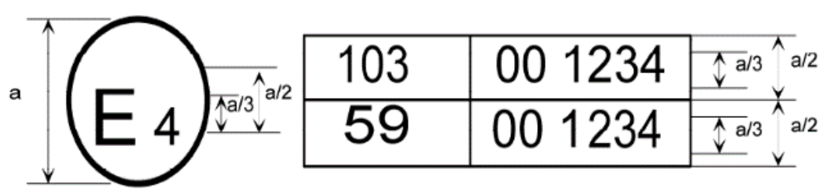


a = 8 mm min

The above approval mark affixed to a component of a replacement pollution control device shows that the type concerned has been approved in the Netherlands (E 4), pursuant to Regulation No. 103 under approval No. 001234. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 103 in its original form.

MODEL B

(See paragraph 4.7. of this Regulation)



a = 8 mm min

The above approval mark affixed to a component of replacement pollution control device shows that the type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 103 and 59

The first two digits of the approval numbers indicate that, on the date on which these approvals were granted, Regulations Nos. 103 and 59 were in their original form.

UN Regulation No. 127 (Pedestrian Safety)

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraph 5. below, approval of that vehicle shall be granted.

4.2. An approval number shall be assigned to each type approved; its first two digits (at present 02 corresponding to the 02 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1, Part 2 and photographs and/or plans supplied by the applicant being in a format of no more than A4 (210 x 297 mm), or folded to that format, and on an appropriate scale.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark conforming to the model described in Annex 2, consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;28

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1. above.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations, annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. needs not be repeated; in such a case, the Regulation and approval numbers and the additional symbols shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. above.

4.6. The approval mark shall be clearly legible and be indelible.

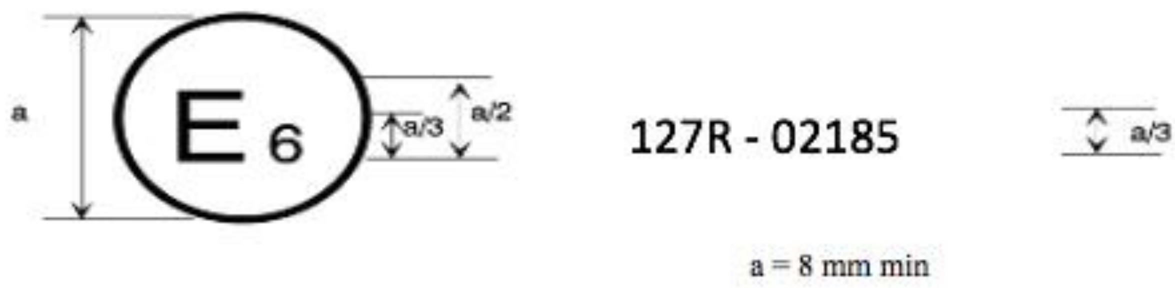
4.7. The approval mark shall be placed close to or on the vehicle data plate.

[28] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

ANNEX 2

Arrangements of Approval Marks

(See paragraphs 4.4. to 4.4.2. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E 6) with regard to its pedestrian safety performance pursuant to UN Regulation No. 127. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of UN Regulation No. 127 as amended by the 02series of amendments.

UN Regulation No. 129 (Reinforced Child Restraint Systems (RCRS))

4. Markings

4.1. The samples of Enhanced Child Restraint Systems, including all modules submitted for approval in conformity with the provisions of paragraphs 3.2.4. and 3.2.5. above shall be clearly and indelibly marked with the manufacturer's name, initials or trade mark.

4.2. The Enhanced Child Restraint System, including all modules, except the strap(s) or harness, shall be marked clearly and indelibly with the year of production.

4.3. The orientation of the Enhanced Child Restraint System relative to the vehicle. The size range(s) of the Enhanced Child Restraint System in centimetres and the maximum occupant mass allowed for the Integral Enhanced Child Restraint System in kilograms shall be clearly indicated on the product part hosting the child.

The marking defined in this paragraph shall be visible with the Enhanced Child Restraint System in the vehicle, with the child in the Enhanced Child Restraint System.

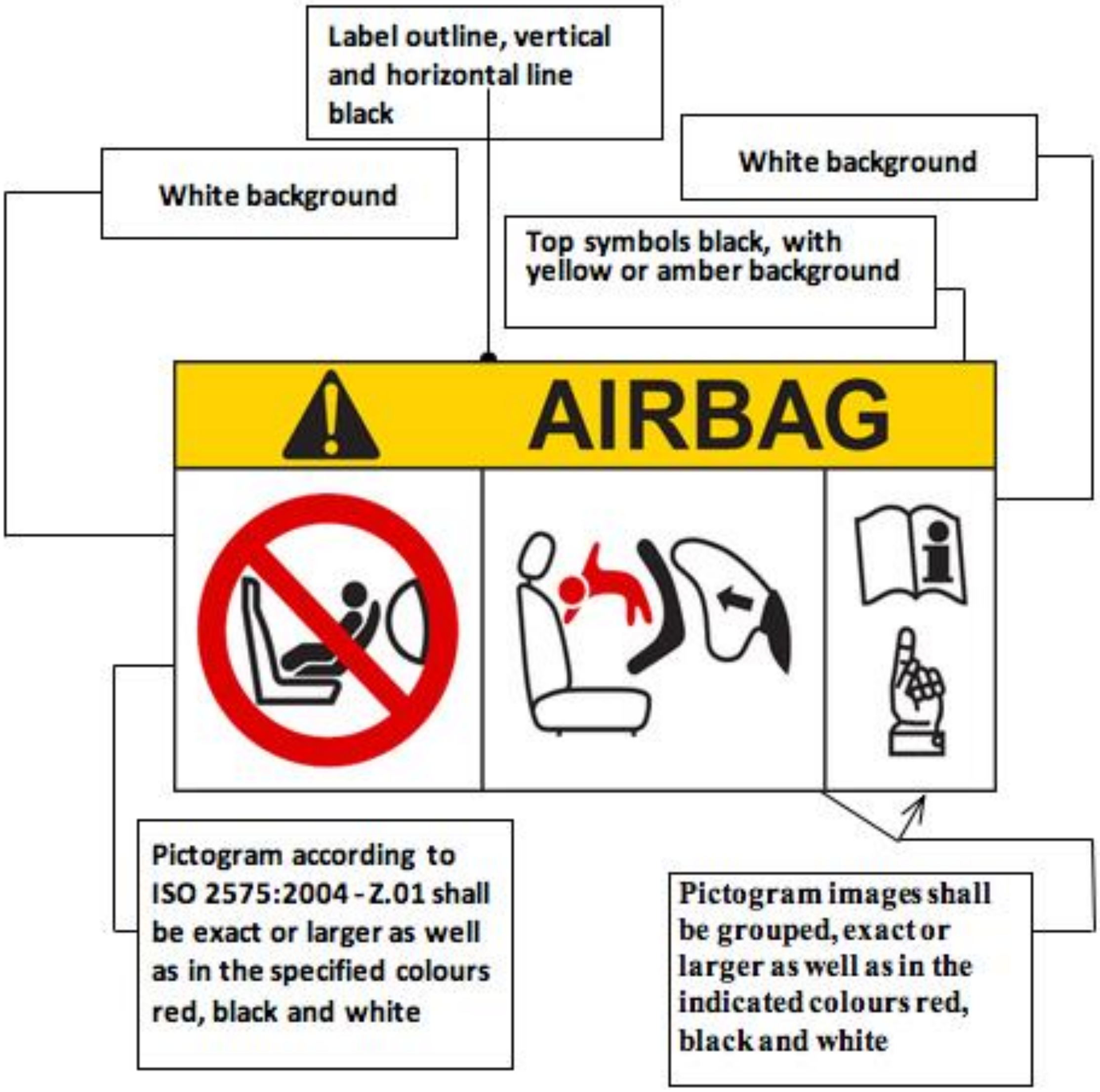
4.4. On the visible inner surface (including the side wing beside the child's head) in the approximate area where the child's head rests within the Enhanced Child Restraint System, rearward facing restraints shall have the following label permanently attached (the information shown is a minimum).

Label minimum size: 60 x 120 mm.

The label shall be stitched to the cover around its entire perimeter and/or permanently bonded to the cover over its entire back surface. Any other form of attachment that is permanent and not liable to removal from the product or to becoming obscured is acceptable. Flag type labels are specifically prohibited.

If sections of the restraint or any accessories supplied by the Enhanced Child Restraint System manufacturer are able to obscure the label an additional label is required. One warning label shall be permanently visible in all situations when the restraint is prepared for use in any configuration.

Figura A5. The Enhanced Child Restraint System in the vehicle Label

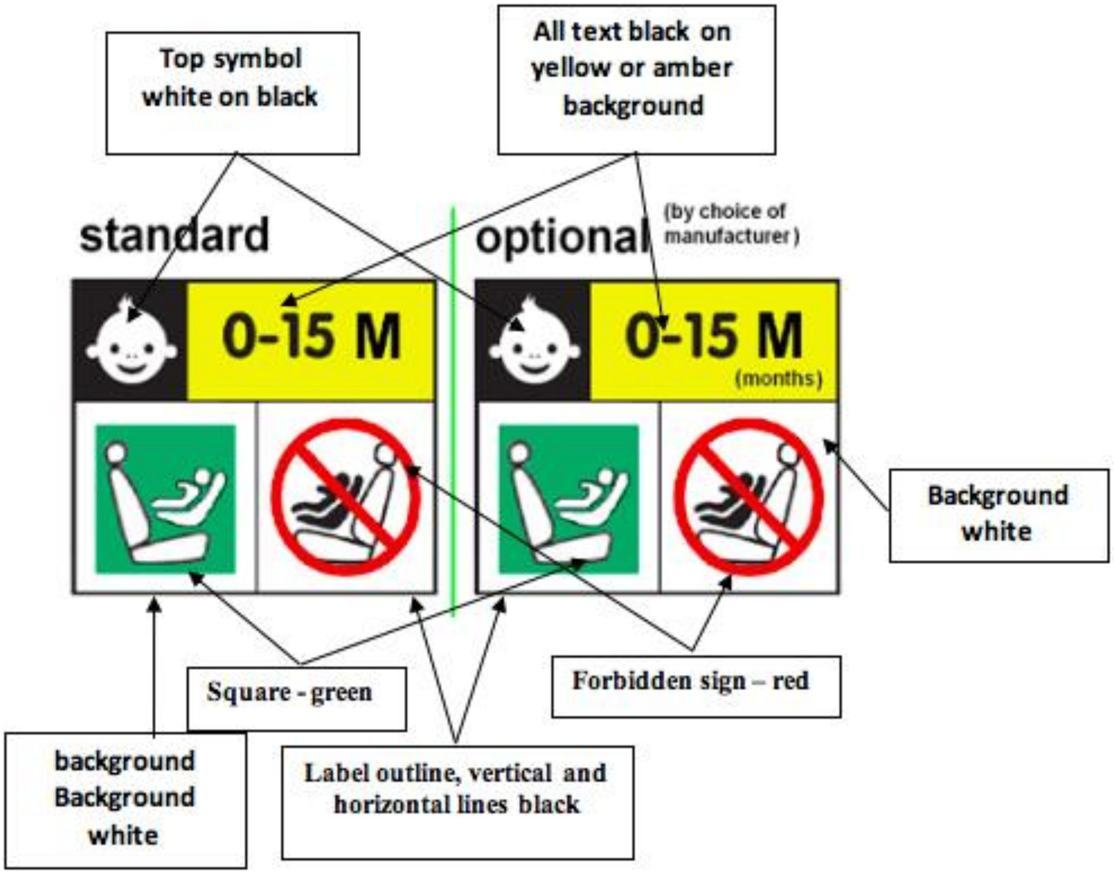


4.5. In the case of Integral Enhanced Child Restraint Systems that can be used forward facing, it shall have the following label permanently attached on the part hosting the child and visible to the person installing an Enhanced Child Restraint System in the vehicle:

The manufacturer shall be permitted to include the word "months" to explain the symbol "M" in the label. The word "months" should be in a language commonly spoken in the country or countries where the product is sold. More than one language is allowed.

Figura A6. Enhanced Child Restraint System Label

Minimum label size 40 x 40 mm



4.6. Marking for integral ECRS including ISOFIX connections.

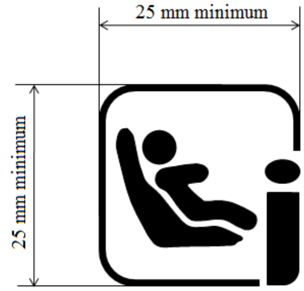
The marking shall be located on the part of the ECRS which includes the ISOFIX connectors.

One of the following information labels shall be permanently visible to someone installing the Enhanced Child Restraint System in a vehicle:

4.6.1. i-Size ECRS:

i-Size logo. The symbol shown below shall have minimum dimension of 25 x 25 mm and the pictogram shall contrast with the background. The pictogram shall be clearly visible either by means of contrasting colors or by adequate relief if it is moulded or embossed;

Figura A7. **i-Size logo**



4.6.2. Specific Vehicle ISOFIX ECRS

If the product includes ISOFIX attachments, the following information shall be permanently visible to someone installing the restraint in a vehicle:

The ISO ISOFIX logo followed by the letter(s) that is/are appropriate for the ISOFIX size class(es) into which the product fits. As a minimum, a symbol consisting of a circle with a diameter of minimum 13 mm and containing a pictogram, the pictogram shall contrast with the background of the circle. The pictogram shall be clearly visible either by means of contrast colors or by adequate relief if it is moulded or embossed.

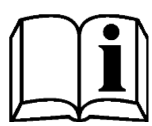
Figura A8. **The ISO ISOFIX logo**

B, C and F

The *Specific vehicle ISOFIX* Enhanced Child Restraint System shall have a permanently attached label visible to the person installing the Enhanced Child Restraint System in the car, containing the following information:

Figura A9. Symbol to the Child Restraint User Instructions

Specific Vehicle ISOFIX



4.6.3. An international approval mark as defined in paragraph 5.4.1. In case the ECRS containing module(s) this marking shall be permanently attached to the part of the ECRS which includes the ISOFIX connectors.

4.6.4. An international module mark as defined in paragraph 5.4.3. In case the ECRS containing module(s) this marking shall be permanently attached to the module part of the ECRS.

4.7. Additional markings

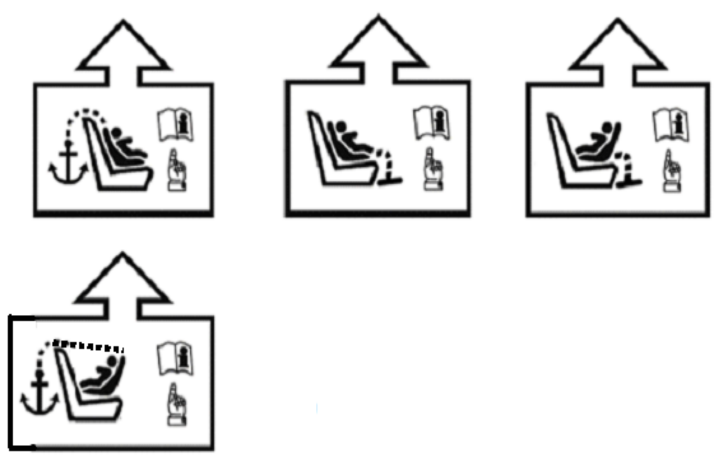
The following information may be conveyed by pictograms and/or text. The marking shall indicate:

a) The essential relevant steps needed for making the Enhanced Child Restraint System ready for installation. For example, the method of extending the ISOFIX attachment(s) shall be explained;

b) The position, function, and interpretation of any indicator shall be explained;

c) The position and if necessary the routing of top tethers, or other means of limiting Enhanced Child Restraint System rotation requiring action by the user, shall be indicated using one of the following symbols as appropriate;

Figura A10. The essential relevant steps needed for making the seat ready for installation by pictograms

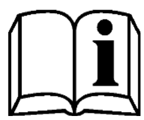


d) The adjustment of ISOFIX latches and the top tether, or other means of limiting Enhanced Child Restraint System rotation, requiring action by the user shall be indicated;

e) The marking shall be permanently attached and be visible to a user installing the Enhanced Child Restraint System;

f) Where necessary reference should be made to the Enhanced Child Restraint System user instructions and to the location of that document using the symbol below.

Figura A11. **Symbol to the Child Restraint User Instructions**



ANNEX 2

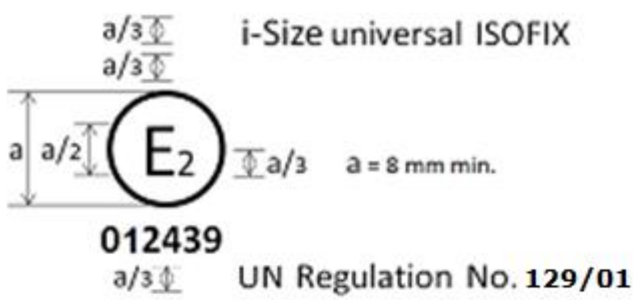
Arrangements of the Approval Mark

The Enhanced Child Restraint System bearing the above approval mark is a device capable of being fitted in any i-size compatible vehicle seating position and of being used for the 40 cm - 70 cm size range and mass limit of 24 kg; it is approved in France (E 2) under the number 012439. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of Enhanced Child Restraint Systems used onboard of motor vehicles as amended by the 01 series of amendments. In addition, the name of this Regulation has to be identified on the approval mark followed by the series of amendment according to which the approval has been granted.

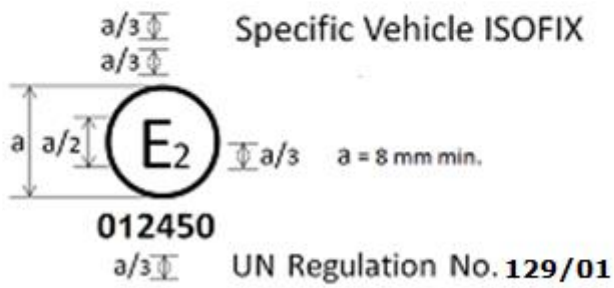
The Enhanced Child Restraint System bearing the above approval mark is a device not capable of being fitted in every vehicle and capable of being used for the 40 cm - 70 cm size range and mass limit of 24 kg; it is approved in France (E 2) under the number 012450. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of Specific vehicle ISOFIX Enhanced Child Restraint Systems used onboard of motor vehicles as amended by the 01 series of amendments. In addition, the name of this Regulation has to be identified on the approval mark followed by the series of amendment according to which the approval has been granted.

In case the ECRS is equipped with a module, the size range is not on the approval mark but on the module mark.

Arrangements of the Approval Mark in Combination with a Module Mark

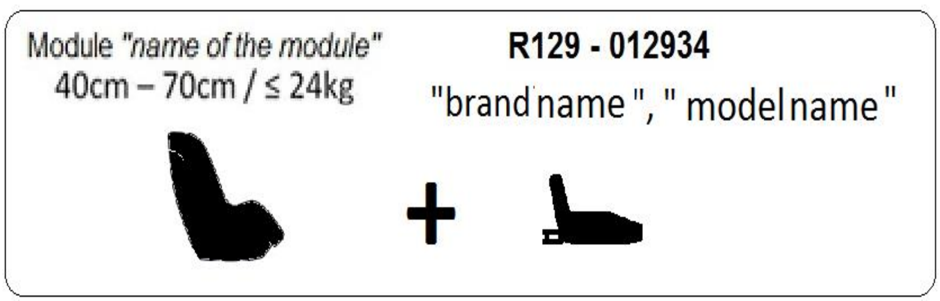


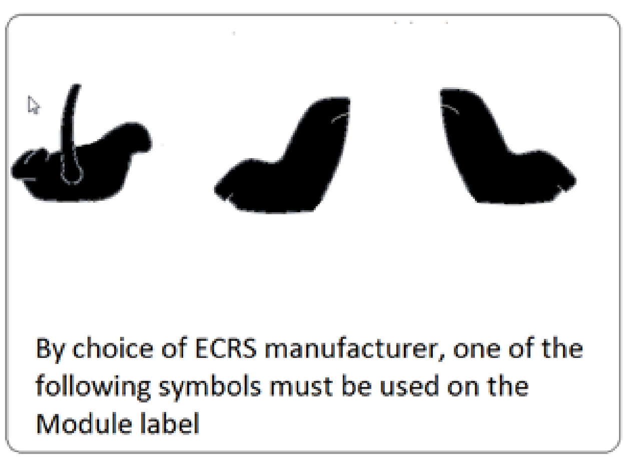
The Enhanced Child Restraint System bearing the above approval mark is a device, including module(s), capable of being fitted in any i-size compatible vehicle seating position. It is approved in France (E 2) under the number 012439. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of Enhanced Child Restraint Systems used onboard of motor vehicles as amended by the 01 series of amendments. In addition, the name of this Regulation has to be identified on the approval mark followed by the series of amendment according to which the approval has been granted.



The Enhanced Child Restraint System bearing the above approval mark is a device, including module(s), not capable of being fitted in every vehicle. It is approved in France (E 2) under the number 012450. The approval number indicates that the approval was granted in accordance with the requirements of the Regulation concerning the approval of Specific vehicle ISOFIX Enhanced Child Restraint Systems used onboard of motor vehicles as amended by the 01 series of amendments. In addition, the name of this Regulation has to be identified on the approval mark followed by the series of amendment according to which the approval has been granted.

Figura A12. Example of arrangements of the module mark in combination with an approval mark





The Enhanced Child Restraint System module bearing the above module mark capable of being used for the 40 cm - 70 cm size range and mass limit of 24 kg; it is approved under the number 012439 to be used in combination with device approved according to UN Regulation No. 129 under the same number 012439. The approval number indicates that the approval was granted in accordance with the requirements of this Regulation concerning the approval of Enhanced Child Restraint Systems used onboard of motor vehicles as amended by the 01 series of amendments.

UN Regulation No. 135 (Pole Side Impact (PSI))

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraph 5 below, approval of that vehicle type shall be granted.

4.2. In case of doubt, account shall be taken, when verifying the conformity of the vehicle to the requirements of this Regulation, of any data or test results provided by the manufacturer which can be taken into consideration in validating the approval test carried out by the Technical Service.

4.3. An approval number shall be assigned to each vehicle type approved. Its first two digits (at present 01 corresponding to the 01 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same approval number to another vehicle type.

4.4. Notice of approval or of extension or of refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1 of this Regulation and photographs and/or diagrams and drawings supplied by the applicant for approval, in a format of no more than A4 (210 x 297) mm or folded to that format and on an appropriate scale.

4.5. There shall be affixed to every vehicle conforming to a vehicle type approved under this Regulation, conspicuously and in a readily accessible place specified on the approval form, an international approval mark consisting of:

4.5.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval; 29

4.5.2. The number of this Regulation, followed by the letter "R", a dash and the approval number, to the right of the circle prescribed in paragraph 4.5.1.

[29] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 3, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

4.6. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.5.1. need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.5.1.

4.7. The approval mark shall be clearly legible and shall be indelible.

4.8. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.9. Annex 2 to this Regulation gives examples of approval marks.

ANNEX 2

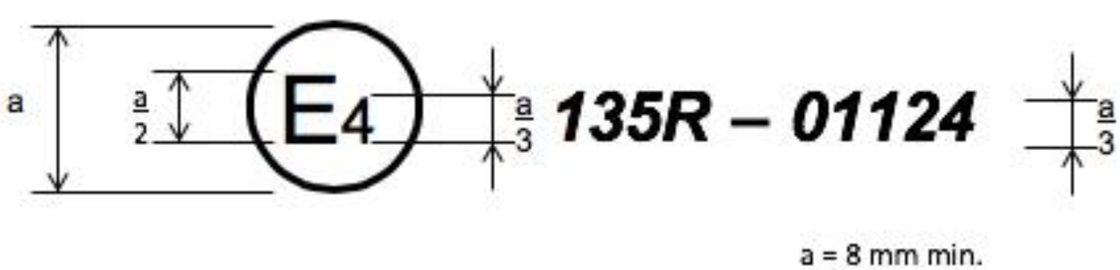
Arrangement of the Approval Mark

<u>5. MODEL A</u>

(See paragraph 4.5. of this Regulation)

MODEL A

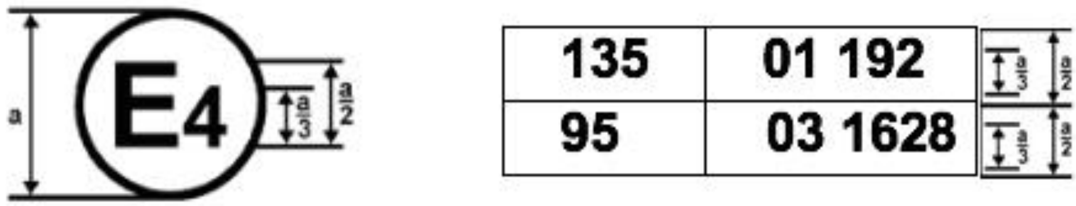
(See paragraph 4.5. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to its pole side impact performance, been approved in the Netherlands (E 4) pursuant to Regulation No. 135 under approval number 00124. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No. 135 as amended by the 01 series of amendments.

<u>6. MODEL B</u>

(See paragraph 4.6. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) pursuant to Regulations Nos. 135 and 95.[30] The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No. 135 incorporated the 01 series of amendments and Regulation No. 95 incorporated the 03 series of amendments.

UN Regulation No. 140 (Electronic Stability Control systems))

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval,[31] and of

4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1. above.

4.5. If the vehicle conforms to a vehicle type approved under one or more other regulations, annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. above, need not be repeated; in such a case, the regulation and approval numbers and the additional symbols of all the regulations under which approval has been granted in the country which has granted approval under

[30] The latter number is given only as an example.

[31] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 4, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1. above.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate.

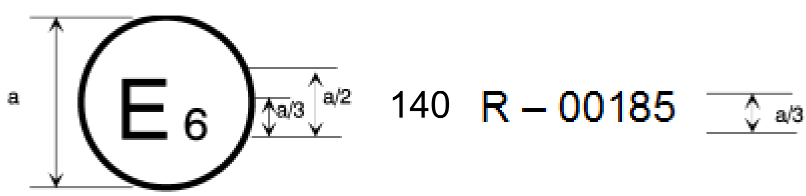
4.8. Annex 2 to this Regulation gives examples of arrangements of approval marks.

Annex 2

Arrangements of Approval Marks

Model A

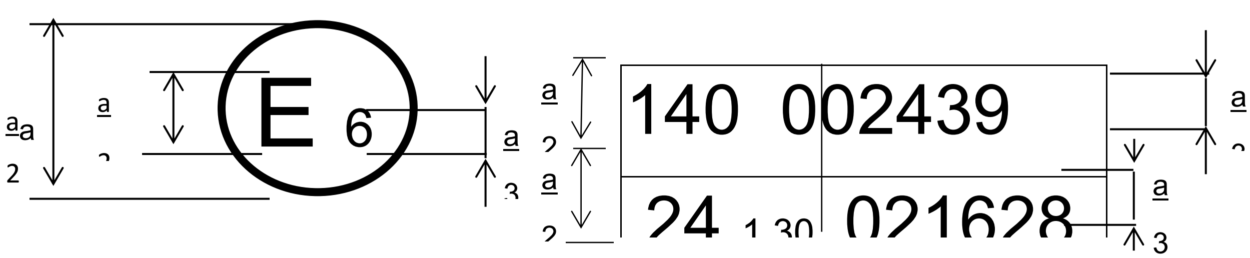
(See paragraph 4.4. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E 6) with regard to the Electronic Stability Control pursuant to Regulation No. 140. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 140 in its original form.

Model B

(See paragraph 4.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E 6) pursuant to Regulations Nos. 140 and 24.[32] (In the case of the latter Regulation the corrected absorption coefficient is 1.30 m-1). The approval numbers indicate that, at the dates when the respective approvals were given, Regulation No. 140 was in its original form and Regulation No. 24 included the 02 series of amendments

UN Regulation No. 145 (ISOFIX anchorage systems, ISOFIX top tether anchorages and i-Size seating positions)

4. Approval

4.1. If the vehicle submitted for approval pursuant to this Regulation meets the relevant requirements of this Regulation, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type as defined in paragraph 2.2. above.

4.3. Notice of approval or of extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to the Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;33

4.4.2. The number of this Regulation, to the right of the circle prescribed in paragraph 4.4.1.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations Annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a

[32] This number is given merely as an example.

[33] The distinguish numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6. www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

case the additional numbers and symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

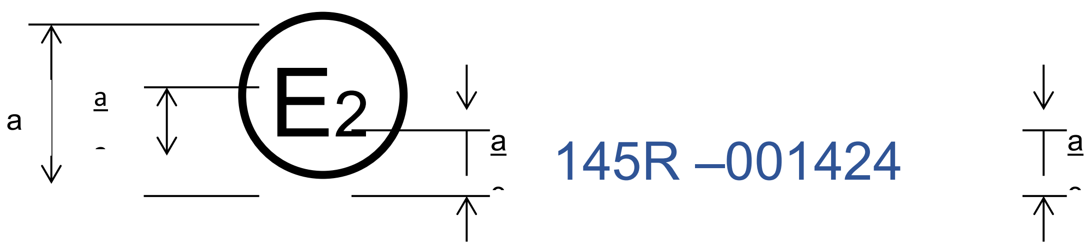
4.8. Annex 2 to this Regulation gives examples of arrangements of the approval mark.

ANNEX 2

Arrangements of the Approval Mark

MODEL A

(see paragraph 4.4. of this Regulation)

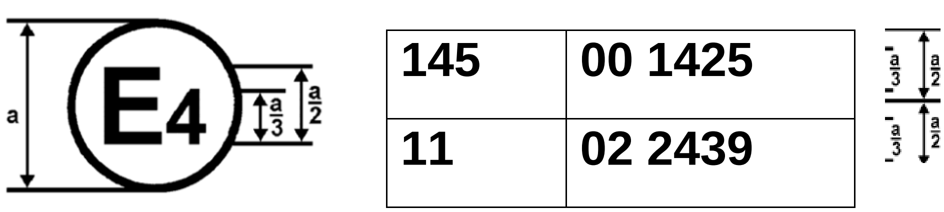


a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to ISOFIX anchorages systems, and ISOFIX top tether anchorages and i-Size seating positions -belt anchorages, been approved in France (E 24), pursuant to UN Regulation No. 145, under the number 001424. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of UN Regulation No. 145 00 series of amendments.

MODEL B

(see paragraph 4.5. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to UN Regulations Nos. 145 and 11[34]. The approval numbers indicate that on the dates on which these approvals were granted, UN Regulation No. 145 00 series of amendments and UN Regulation No. 11 was in its 02 series of amendments.

[34] The second number is given merely as an example.

Schedule I-6. Equivalences between the Euro emission limits and the limits of UN Regulations No. 49 and 83

Table A4. Equivalences Euro 1 to 6 – UN Regulation No. 83

Vehicle class	Pollutant emission regulation	EU regulatory text	Entry into force	UN Regulation No.	Entry into force	Test
M_1	Euro 1	Directive 91/441/EEC	jul-92	83.01 (Rev.1)	dec-92	EDC
	Euro 2	Directive 94/12/EC	jan-96	83.03 (Rev. 1 amend. 2)	dec-96	EDC
	Euro 3	Directive 98/69/EC; A-2000	jan-00	83.05 (Rev. 2); A-2000	mar-01	NEDC
	Euro 4	Directive 98/69/EC; B-2005	jan-05	83.05 (Rev. 2); B-2005	mar-01	NEDC
	Euro 5	Regulation 715/2007/EC	sep-09	83.06 (Rev. 4)	dec-10	NEDC
	Euro 6	Regulation 715/2007/EC	sep-14	83.07 (Rev. 5)		NEDC
N_1	Euro 1	Directive 93/59/EEC	oct-94	83.02 (Rev. 1 amend. 1)	mar-01	EDC
	Euro 2	Directive 96/69/EC	jan-98	83.04 (Rev. 1 amend. 4)	nov-99	EDC
	Euro 3	Directive 98/69/EC; A-2000	jan-00	83.05 (Rev. 2); A-2000	mar-01	NEDC
	Euro 4	Directive 98/69/EC; B-2005	jan-05	83.05 (Rev. 2); B-2005	mar-01	NEDC
	Euro 5	Regulation 715/2007/EC	sep-09	83.06 (Rev. 4)	dec-10	NEDC
	Euro 6	Regulation 715/2007/EC	sep-14	83.07 (Rev. 5)		NEDC

Table A5. Equivalences Euro I to VI– UN Regulation No. 49

Pollutant emission regulation	EU regulatory text	Entry into force	UN Regulation No.	Entry into force	Test
Euro 0	Directive 88/77/EEC				R49
Euro I	Directive 91/542/EEC	jan-92	49.02 (Rev.2); A-1992	dec-92	R49
Euro II	Directive 91/542/EEC	oct-98	49.02 (Rev.2); B-1995	dec-92	R49
Euro III	Directive 1999/96/EC	jan-00	49.03 (Rev.3 amend.1); A-2000	dec-01	ESC (steady-state) and ELR (smoke)
Euro III	Directive 1999/96/EC	jan-00	49.03 (Rev.3 amend.1); A-2000	dec-01	ETC (transient)
Euro IV	Directive 1999/96/EC	jan-05	49.03 (Rev.3 amend.1); B1-2005	dec-01	ESC (steady-state) and ELR (smoke)
Euro IV	Directive 1999/96/EC	jan-05	49.03 (Rev.3 amend.1); B1-2005	dec-01	ETC (transient)
Euro V	Directive 1999/96/EC	jan-08	49.03 (Rev.3 amend.1); B2-2008	dec-01	ESC (steady-state) and ELR (smoke)
Euro V	Directive 1999/96/EC	jan-08	49.03 (Rev.3 amend.1); B2-2008	dec-01	ETC (transient)
EEV	Directive 1999/96/EC	jan-00	49.03 (Rev.3 amend.1); C	dec-01	ESC (steady-state) and ELR (smoke)
EEV	Directive 1999/96/EC	jan-00	49.03 (Rev.3 amend.1); C	dec-01	ETC (transient)
Euro VI	Regulation 595/2009	jan-14	49.06 (Rev. 6)		WHSC (steady-state)
Euro VI	Regulation 595/2009	jan-14	49.06 (Rev. 6)		WHTC (transient)

Table A6. Fuel quality – emission limit

Gasoline – on road vehicles

Unleaded Gasoline	***R83.03***	***R83.05 (row A)***	***R83.05 (row B)***	***Test method***
Lead [g/l]	No intentional addition, with a max ≤ 0.013	No intentional addition, with a max ≤ 0.005	No intentional addition, with a max ≤ 0.005	EN 237
Sulphur [mg/kg]	≤ 500	≤ 150	≤ 50 [1]	EN ISO 20846 EN ISO 20884
Metal Additives [mg/l]	---------------- Not permitted ----------------			
Oxygen [%m/m]	≤ 2.7	≤ 2.7	≤ 2.7	EN 1601 EN 13132
Oxygenates [%v/v] - methanol - ethanol - iso-propyl alcohol - iso-butyl alcohol - tert-butyl alcohol - ethers - other oxygenates	 ≤ 3.0 [2] ≤ 5.0 ≤ 10.0 ≤ 10.0 ≤ 7.0 ≤ 15.0 ≤ 10.0	 ≤ 3.0 [2] ≤ 5.0 ≤ 10.0 ≤ 10.0 ≤ 7.0 ≤ 15.0 ≤ 10.0	 ≤ 3.0 [2] ≤ 5.0 ≤ 10.0 ≤ 10.0 ≤ 7.0 ≤ 15.0 ≤ 10.0	EN 1601 EN 13132
RVP [kPa]	35 - 100	45 – 100	45 – 100	EN 13016/I DVPE
Density [kg/m^3]	725 – 780	720 – 775	720 – 775	EN ISO 3675 EN ISO 12185
RON	≥ 95	≥ 95	≥ 95	EN ISO 5164
MON	≥ 85	≥ 85	≥ 85	EN ISO 5163
Benzene [%v/v]	≤ 5	≤ 1	≤ 1	EN 238 EN 14517
Aromatics [%v/v]	-	≤ 42	≤ 35	EN 14517 EN15553
Olefins [%v/v]	-	≤ 18	≤ 18	EN 14517 EN15553
VLI (10VP + E70)	-	1 050 – 1 250	1 050 – 1 250	
Residue [%v/v]	< 2	< 2	< 2	EN ISO 3405

[1]Corresponds to the United Nations Environment Programme (UNEP) decision taken at the fourth global meeting of the Partnership for Clean Fuels and Vehicles (PCFV), held on 14 and 15 December 2005 in Nairobi, Kenya.

[2] Industry recommends no methanol content (non-detectable).

Table A7. Fuel quality – emission limit

Diesel – on-road vehicles

	R83 – 03 series and R49.02 (Stage II)	*R83.05 (row A) and R49.03 (row A)*	*R83.05 (row B) and R49.03 (row B)*	*Test method*
Sulphur [mg/kg]	≤ 500	≤ 350	≤ 50[1]	EN ISO 20846 EN ISO 20884
Ash [%m/m]	≤ 0.01	≤ 0.01	≤ 0.01	EN/ISO 6245
Total, Contamination [mg/kg]	≤ 24	≤ 24	≤ 24	EN 12662
Cetane Number [2]	≥ 49	≥ 51	≥ 51	EN ISO 5165
Cetane Index [2]	≥ 46	≥ 46	≥ 46	EN ISO 4264
Density [kg/m^3] [2]	820 – 860	820 – 845	820 – 845	EN ISO 3675 EN ISO 12185
Viscosity [mm^2/s] [2]	2.0 - 4.5	2.0 - 4.5	2.0 – 4.5	EN ISO 3104
Flash Point [°C]	> 55	> 55	> 55	EN ISO 2719
T50 [°C]	-	T65 = 250 min	T65 = 250 min	EN ISO 3405
T85 [°C]	≤ 350	≤ 350	≤ 350	EN ISO 3405
T95 [°C]	≤ 370	≤ 360	≤ 360	EN ISO 3405
PAH [%m/m]	≤ 11	≤ 11	≤ 11	EN 12916
Carbon residue [%m/m]	≤ 0.3	≤ 0.3	≤ 0.3	EN ISO 10370
CFPP [°C] [2]	-44 to +5	-44 to +5	-44 to +5	EN 116
Cloud Point [°C] (severe winter conditions) [2]	-34 to -10	-34 to -10	-34 to -10	EN 23015
Copper strip corrosion (3h at 50°C) [rating]	Class 1			EN ISO 2160

	R83 – 03 series and R49.02 (Stage II)	R83.05 (row A) and R49.03 (row A)	R83.05 (row B) and R49.03 (row B)	Test method
Water [mg/kg]	≤ 200	≤ 200	≤ 200	EN ISO 12937
Lubricity [micron]	≤ 460	≤ 460	≤ 460	EN ISO 12156-1
Oxidation stability [hours] [3]	> 20	> 20	> 20	EN15751
FAME [%v/v]	[4]	[4]	[4]	EN14214 ASTM D6751
Appearance	Clear and bright, no free water or particulates			D4176 visual inspection
Ethanol/Methanol [%v/v]	Non-detectable [5]			

[1] Corresponds to the United Nations Environment Programme (UNEP) decision taken at the fourth global meeting of the Partnership for Clean Fuels and Vehicles (PCFV), held on 14 and 15 December 2005 in Nairobi, Kenya.

[2] Implementing country to choose value appropriate within range for arctic or severe winter conditions. More detailed arctic or severe winter specifications for these parameters to be considered.

[3] Applicable for diesel containing more than 2 per cent v/v FAME.

[4] Up to 5 per cent v/v FAME permitted if FAME complies with ASTM D6751. Up to 7 per cent v/v FAME permitted if FAME complies with EN14214. Industry recommends that vehicle owners refer to their vehicle handbook.

[5] At or below detection limit of method used.

In order to know the real situation of fuel quality in the region, it would be convenient to carry out a chemical study of fuel quality.

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Table A8. Fuel quality – emission limit

Diesel – of-road vehicles

	R83 - 03series and R49.02 (Stage II)	***R83.05 (row A) and R49.03 (row A)***	***R83.05 (row B) and R49.03 (row B)***	***Test method***
Sulphur [mg/kg]	≤ 500	≤ 350	≤ 50[1]	EN ISO 20846 EN ISO 20884
Ash [%m/m]	≤ 0.01	≤ 0.01	≤ 0.01	EN/ISO 6245
Total, Contamination [mg/kg]	≤ 24	≤ 24	≤ 24	EN 12662
Cetane Number [2]	≥ 49	≥ 51	≥ 51	EN ISO 5165
Cetane Index [2]	≥ 46	≥ 46	≥ 46	EN ISO 4264
Density [kg/m^3] [2]	820 – 860	820 – 845	820 – 845	EN ISO 3675 EN ISO 12185
Viscosity [mm^2/s] [2]	2.0 - 4.5	2.0 - 4.5	2.0 – 4.5	EN ISO 3104
Flash Point [°C]	> 55	> 55	> 55	EN ISO 2719
T50 [°C]	-	T65 = 250 min	T65 = 250 min	EN ISO 3405
T85 [°C]	≤ 350	≤ 350	≤ 350	EN ISO 3405
T95 [°C]	≤ 370	≤ 360	≤ 360	EN ISO 3405
PAH [%m/m]	≤ 11	≤ 11	≤ 11	EN 12916
Carbon residue [%m/m]	≤ 0.3	≤ 0.3	≤ 0.3	EN ISO 10370
CFPP [°C] [2]	-44 to +5	-44 to +5	-44 to +5	EN 116
Cloud Point [°C] (severe winter conditions) [2]	-34 to -10	-34 to -10	-34 to -10	EN 23015

	R83 - 03series and R49.02 (Stage II)	*R83.05 (row A) and R49.03 (row A)*	*R83.05 (row B) and R49.03 (row B)*	*Test method*
Copper strip corrosion (3h at 50°C) [rating]	Class 1			EN ISO 2160
Water [mg/kg]	≤ 200	≤ 200	≤ 200	EN ISO 12937
Lubricity [micron]	≤ 460	≤ 460	≤ 460	EN ISO 12156-1
Oxidation stability [hours] [3]	> 20	> 20	> 20	EN15751
FAME [%v/v]	[4]	[4]	[4]	EN14214 ASTM D6751
Appearance	Clear and bright, no free water or particulates			D4176 visual inspection
Ethanol/Methanol [%v/v]	Non-detectable [5]			

[1] Corresponds to the United Nations Environment Programme (UNEP) decision taken at the fourth global meeting of the Partnership for Clean Fuels and Vehicles (PCFV), held on 14 and 15 December 2005 in Nairobi, Kenya.
[2] Implementing country to choose value appropriate within range for arctic or severe winter conditions. More detailed arctic or severe winter specifications for these parameters to be considered.
[3] Applicable for diesel containing more than 2 per cent v/v FAME.
[4] Up to 5 per cent v/v FAME permitted if FAME complies with ASTM D6751. Up to 7 per cent v/v FAME permitted if FAME complies with EN14214. Industry recommends that vehicle owners refer to their vehicle handbook.
[5] At or below detection limit of method used.

In order to know the real situation of fuel quality in the region, it would be convenient to carry out a chemical study of fuel quality.

PART II SCHEDULES

Schedule II-1. Methods

1A. Comparative Risk Assessment

The methodological basis of the analysis is the epidemiological concept of attributable risk, which is the difference in the rate of a condition between an exposed and unexposed population. Such risks include, for example, exposure to injuries caused by poorly designed cars. This concept has been implemented in GBD (Global Burden of Disease) using the comparative risk assessment (CRA) framework. In summary, the CRA estimates the burden of injury due to risk factors using a contrasting approach. The population-attributable fraction (PAF) of a risk factor is estimated as the expected *proportional* reduction in mortality if exposure to such risk factors were reduced to an alternative (counterfactual) distribution, due to improvements made in vehicle design. Therefore, for a continuous variable:

$$PAF = \frac{\int_{x=0}^{m} RR(x)P(x)\,dx - \int_{x=0}^{m} RR(x)P'(x)\,dx}{\int_{x=0}^{m} RR(x)P(x)\,dx}$$

..... [1]

Where *x,* is the exposure level, P(*x*) is the actual population distribution of the exposure, P'(*x*) is the counterfactual (alternative) exposure distribution of the population, RR (x) is the relative mortality risk at exposure level *x*, and *m* is the maximum exposure level.

And, for a categorical exposure:

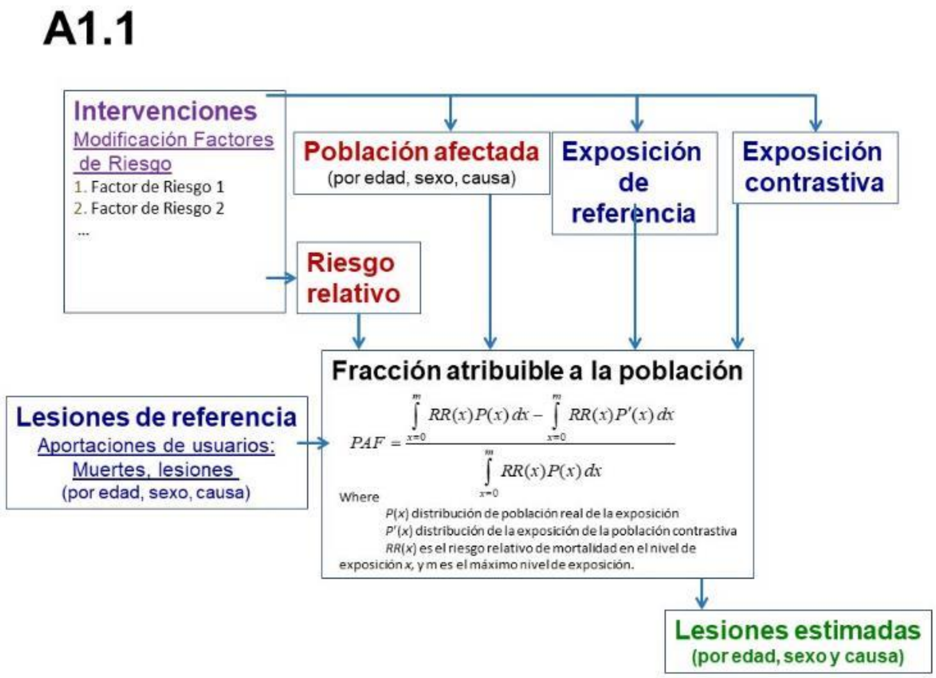
$$PAF = \frac{\sum_{i=1}^{n} P_i\ RR_i - \sum_{i=1}^{n} P_i'\,RR_i}{\sum_{i=1}^{n} P_i\ RR_i}$$

..... [2]

where *n,* x is the number of exposure categories, P*i* is the proportion of the population currently in exposure category i, P'*i* is the proportion of the population in exposure category *i* in the counterfactual (alternative) scenario and RR*i*: relative risk of disease-specific mortality for exposure category *i*.

The global burden of disease includes CRA for a wide range of health risks, but does not include CRA for most risk factors for road traffic injuries. In addition to alcohol risk assessment, which includes estimates of road traffic injuries attributed to alcohol-impaired driving, no previous studies have been conducted to estimate the global or regional burden of avoided injuries due to the adoption of vehicle crash resistance standards

Figure A1.1. General description for the CRA module



<table>
<tr><td rowspan="2">Interventions
Modification of risk factors
1. Risk Factor 1
2. Risk factor 2</td><td>Affected populations
(by age, sex, cause)</td><td>Reference exposure</td><td>Conterfactual exposure</td></tr>
<tr><td>Relative risk</td><td colspan="2"></td></tr>
<tr><td>Reference injuries
User's contributions:
Death, injuries
(by age, sex, cause)</td><td colspan="3">Fraction attributable to population
$$PAF = \frac{\int_{x=0}^{m} RR(x)P(x)\,dx - \int_{x=0}^{m} RR(x)P'(x)\,dx}{\int_{x=0}^{m} RR(x)P(x)\,dx}$$
Where
P(*x*) actual population distribution of the exposure,
P'(*x*) counterfactual exposure distribution of the population,
RR (x) relative mortality risk at exposure level *x*, and *m* is the maximum exposure level.</td></tr>
<tr><td></td><td></td><td></td><td>Estimated injuries
(by age, sex, cause)</td></tr>
</table>

1B. Injury Burden Estimation Model

A method is needed to estimate relative risks and also to convert estimates of additional deaths and injuries caused by unsafe cars into estimates of general health loss (DALYs). This will be done by using a simplified method of injury burden analysis that broadly follows the global burden of disease (GBD) methodology. The years of life lost (YLLs) will be estimated using the following equation:

YLL (age, sex, external cause) = D (age, sex, external cause) * L (age, sex) [3]

where D is the number of deaths and L is the standard life expectancy for people surviving that age. Estimating the change in injury burden from non-fatal road traffic incidents is a little more complex. The GDB Injury Expert Group analyzed hospital admission data that included information on both injuries (traumatic brain injury, hip fracture, etc.) and their external causes (traffic incident, fall, etc.). Such data will be used to develop mappings of external causes to sequelae of injuries arising from such causes. These data include large administrative and surveillance databases from hospital in 28 countries, including LAC countries:

N (age, sex, external cause, sequelae) = E (age, sex, external cause) * p (age, sex, external cause, sequelae) [4]

where N is the incidence of sequelae, E is the incidence of the external cause of the injuries, and p is the probability of several sequelae occurring for each external cause. Based on the literature review discussed above, the project will evaluate how each WP29 regulation affects N, E or p. Thus, the years lived with disability (YLD) will be estimated as

$$YLD = N * pperm * DWperm * Lp + N*(1-pperm) * DWst*Dst \quad [5]$$

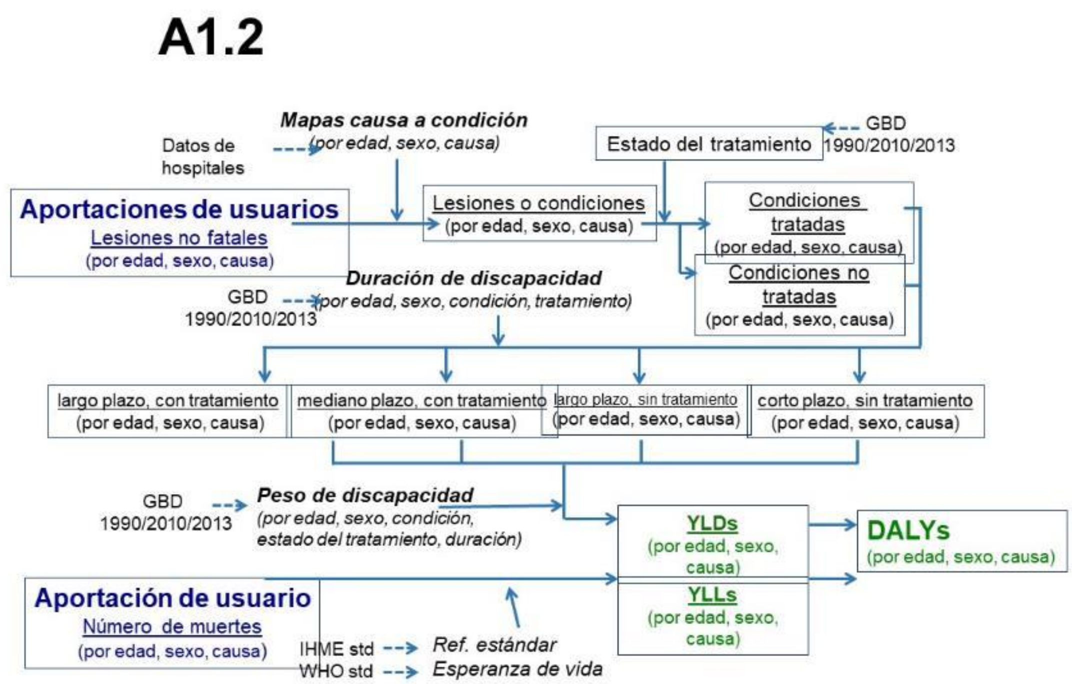
where N, is the number of incident cases of each sequela, pperm is the proportion of cases that will have a permanent disability; DW is the weight of the disability reflecting the severity of the decline in health on a scale of 0 (perfect health) to 1 (death); DWst is the weight of the short-term disability; DWperm is the permanent weight of the disability; Dst is the short-term duration of the deactivation event; and Lp is the life expectancy of the population, reduced (if necessary data are available) to allow for an increase in all-cause mortality among people living with permanent sequelae.

Finally, DALYs are the sum of the mortality and morbidity components

DALYs = YLL + YLD [6]

Bhalla and Harrison (2016) provide a detailed description of methods for estimating the burden of injury on the health of the population from incident case data.[11]

Figure A1.2. Summary of calculations for burden calculation

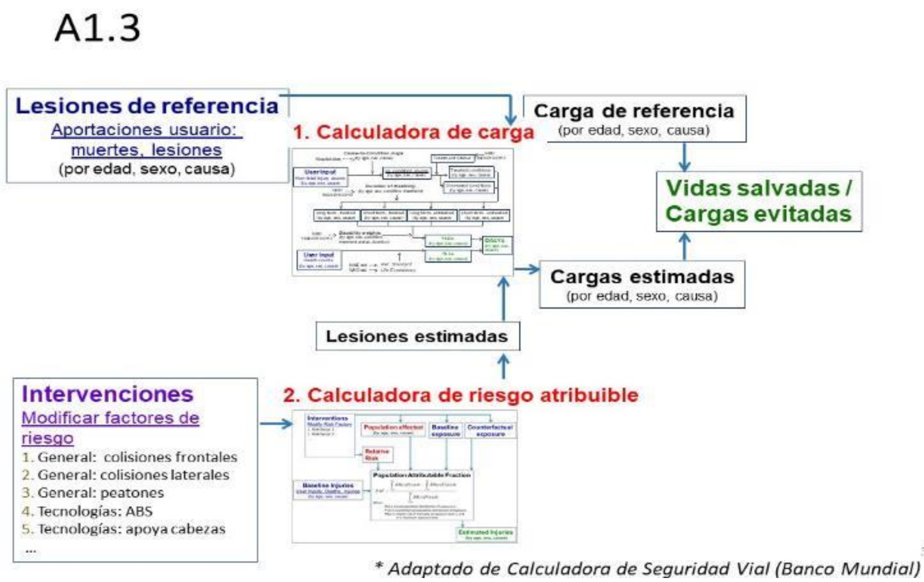


	Cause to condition map (by age, sex, cause)	State of treatment	GBD 1990/2010/2013
Hospital data			
User's contributions Non-fatal injuries (by age, sex, cause)		Injuries or conditions (by age, sex, cause)	Conditions treated (by age, sex, cause)
GBD 1990/2010/2013	Disability duration (by age, sex cause)		Conditions not treated (by age, sex, cause)
Long-term, with treatment (by age, sex, cause)	Medium-term, with treatment (by age, sex, cause)	Long-term, with treatment (by age, sex, cause)	short-term, without treatment (by age, sex, cause)
GBD 1990/2010/2013	Burden of disability (by age, sex, cause, treatment status, duration)	YLDs (by age, sex, cause)	DALYs (by age, sex, cause)
User's contributions Number of death (by age, sex, cause)		YLLs (by age, sex, cause)	
	IHME std WHO std	Standar ref. Life expectancy	

1C. Analytical Strategy

The general analytical strategy involves using the attributable risk calculator (Figure A1.1) and the burden calculator (Figure A1.2) to estimate changes in the number of lives saved and the burden avoided by general changes in car design and the effects of particular interventions.

Figure A1.3. Summary of the general analytical strategy



Reference injuries User's contributions Deaths, injuries (by age, sex, cause)	1. Burden calculator	Reference burden (by age, sex, cause)	Saved lives/ Avoided burdens
	Estimated injuries	Estimated burdens (by age, sex, cause)	
Interventions Modification of risk factors 1. General: frontal collisions 2. General: side collisions 3. General: pedestrains 4. Technologies: ABS 5. Technologies: Headrestraints	2. Attributable risk calculator		

* Adapted from the Safety Road Calculator (World Bank)

Schedule III-2. Literature review

Relevant articles identified in the Literature Review

1. Braver, E. R., & Kyrychenko, S. Y. (2004). Efficacy of side air bags in reducing driver deaths in driver-side collisions. American Journal of Epidemiology, 159 (6), 556–564.

Abstract: "Side air bags, a relatively new technology designed to protect the head and/or torso in side-impact collisions, are becoming increasingly common in automobiles. Their efficacy in preventing US driver deaths among cars struck on the near (driver's) side was examined using data from the Fatality Analysis Reporting System and the General Estimates System. Risk ratios for driver death per nearside collision during 1999–2001 were computed for head/torso and torso-only side air bags in cars from model years 1997–2002, relative to cars without side air bags. Confounding was addressed by adjusting nearside risk ratios for front- and rear-impact mortality, which is unaffected by side air bags. Risk ratios were 0.55 (95% confidence interval: 0.43, 0.71) for head/torso air bags and 0.89 (95% confidence interval: 0.79, 1.01) for torso-only air bags. Risk was reduced when cars with head/torso air bags were struck by cars/minivans (significant) or pickup trucks/sport utility vehicles (nonsignificant). Risk was reduced in two-vehicle collisions and among male drivers and drivers aged 16–64 years. Protective effects associated with torso-only air bags were observed in single-vehicle crashes and among male and 16- to 64-year-old drivers. Head/torso side air bags appear to be very effective in reducing nearside driver deaths, whereas torso-only air bags appear less protective".

2. Chouinard, A., y Lécuyer, J. F. (2011). A study of the effectiveness of Electronic Stability Control in Canada. Crash Analysis and Prevention, 43 (1), 451–460. https://doi.org/10.1016/j.aap.2010.10.001

Abstract: "Electronic Stability Control (ESC) is a crash avoidance system found on many vehicles. Unlike air bags, which only help during a collision, ESC helps to avoid a loss of control that could lead to a collision by preventing skidding. ESC is designed to help the driver stay in control of the vehicle during an emergency manoeuvre, such as when the driver needs to swerve to avoid an obstacle. Our study is an effectiveness evaluation of ESC using crash data. The purpose of a Canadian evaluation study is to examine whether there is an issue with multi-vehicle crashes, and whether ESC is effective in Canadian weather conditions, i.e. on ice, snow and slush. Our results show that ESC is effective for all ESC-sensitive crashes (41.1% effectiveness) and its effectiveness is higher for ESC-sensitive injury crashes only (54.8% effectiveness). In particular, ESC is effective in the case of all multi-vehicle ESC-sensitive crashes (23.2% effectiveness) and of multi-vehicle ESC-sensitive injury crashes (28.4% effectiveness). ESC is also effective for single-vehicle ESC-sensitive crashes, both for all severities of crashes (18.6% effectiveness) and injury crashes only (49.3% effectiveness). The results of the study also show that ESC is effective in Canadian weather conditions (i.e. on ice, snow and slush). The effectiveness of ESC on roads covered with ice, snow and slush is 51.1% for ESC-sensitive crashes of all severities and 71.1% for ESC-sensitive injury crashes. ESC is also effective on dry roads (36.3% effectiveness for ESC-sensitive crashes of all severities and 46.6% effectiveness for ESC-sensitive injury crashes), wet roads (35.8% effectiveness for ESC-sensitive crashes of all severities and 49.5% effectiveness for ESC-sensitive injury crashes) and for both cars (28.5% effectiveness for ESC-sensitive crashes of all severities and 43.7% effectiveness for ESC-sensitive injury crashes) and LTVs (51.9% effectiveness for ESC-sensitive crashes of all severities and 69.6% effectiveness for ESC-sensitive injury crashes)".

3. Cummings, P. (2002). Association of seat belt use with death: a comparison of estimates based on data from police and estimates based on data from trained crash investigators, 8 (4), 338–341.

Abstract - "Objective: Estimates of any protective effect of seat belts could be exaggerated if some crash survivors falsely claimed to police that they were belted in order to avoid a fine. The aim of this study was to determine whether estimates of seat belt effectiveness differed when based on belt use as recorded by the police and belt use determined by trained crash investigators.

Design. Matched cohort study. Setting: the United States.

Subjects: Adult driver-passenger pairs in the same vehicle with at least one death (n=1689) sampled from crashes during 1988-2000; data from the National Accident Sampling System Crashworthiness Data System.

Main outcome measure: Risk ratio for death among belted occupants compared with those not belted.

Results: Trained investigators determined post-crash seat belt use by vehicle inspections for 92% of the occupants, confidential interviews with survivors for 5%, and medical or autopsy reports for 3%. Using this information, the adjusted risk ratio for belted persons was 0.36 (95% confidence interval 0.29 to 0.46). The risk ratio was also 0.36 using police reported belt use for the same crashes.

Conclusions: Estimates of seat belt effects based upon police data were not substantially different from estimates which used data obtained by trained crash investigators who were not police officers. These results were from vehicles in which at least one front seat occupant died; these findings may not apply to estimates which use data from crashes without a death".

4. Cummings, P., Koepsell, T. D., Rivara, F. P., Mcknight, B., y Rivara, P. (2008). Air bags and passenger fatality according to passenger age and restraint use and Christopher. Epidemiology, 13 (5), 525–532. https://doi.org/10.1097/01.EDE.0000023969.01958.C

Abstract: "Backgound: Some children have been killed by air bags, leading to advice that young children should not sit in front of an active air bag.

Methods: We conducted a case-control study to estimate the association of passenger air bag presence with death, according to passenger age and seat belt use. We used data from crashes on U.S. public roads in 1992 through 1998. Cases (N = 20,987) were front seat passengers who died, and controls (N = 69,277) were a sample of survivors.

Results: Among restrained passengers, the adjusted relative risk of death for those with a passenger air bag was 0.79 (95% confidence interval [CI] = 0.66-0.94); for children 12 years or younger, the adjusted relative risk was 1.04 (0.65-1.67) [corrected], and for adults 20 years or older it was 0.75 (0.62-0.91) [corrected]. Among unrestrained passengers, the adjusted relative risk was 1.03 (CI = 0.81-1.30); for children 12 years or younger the adjusted relative risk was 1.37 (0.84-2.21) [corrected], and for adults 20 years or older it was 0.96 (0.75-1.24).

Conclusions: Passenger air bags may be a hazard to unrestrained children and of little benefit to unrestrained adults. Our results support the advice that children younger than 13 years should not sit in front of an active air bag".

5. Erke, A. (2008). Effects of electronic stability control (ESC) on accident: A review of empirical evidence. Accident Analysis and Prevention, 40 (1), 167-173. https://doi.org/10.1016/j.aap.2007.05.002

Abstract: "This study summarizes evidence from empirical studies on the effects of electronic stability control (ESC) on accidents in a meta-analysis. Large reductions of single vehicle accidents have been found (−49%; 95% confidence interval: [−55%; −42%]), and smaller but still significant reductions of head-on collisions (−13%; 95% confidence interval: [−17%; −8%]). Multi-vehicle fatal accidents are also significantly reduced (−32%; 95% confidence interval: [−43%; −20%]). The effects can be explained with the potential of ESC to improve driving dynamics and to reduce the probability of loss of control. However, there are significant amounts of heterogeneity in the results, especially for single vehicle accidents, and a sensitivity analysis shows that the results for single vehicle accidents are likely to be affected by publication bias. The results for single vehicle accidents are in excess of what might be expected based on studies that have estimated the total amount of accidents that may be affected by ESC. Consequently, the proportions of accidents that can be avoided by ESC is assumed to be somewhat smaller than suggested by most empirical studies. Properties of the vehicles, time trends, and driver behaviour may have contributed to the large empirical effects".

6. Farmer, C. M. (2006). Effects of Electronic Stability Control: An Update. Traffic Injury Prevention, 7 (4), 319–324.

Abstract – "Objective: An earlier study reported that electronic stability control (ESC) in passenger vehicles reduced single-vehicle crash involvement risk by 41% and single-vehicle fatal crash involvement risk by 56%. The purpose of the present study was to update these effectiveness estimates using an additional year of crash data and a larger set of vehicle models.

Methods. The amount of data increased by half, allowing for separate effectiveness estimates for cars and sport utility vehicles (SUVs) and a more detailed examination of multiple-vehicle crash types. Crash involvement rates per registered vehicle were compared for otherwise identical vehicle models with and without ESC.

Results. Based on all police-reported crashes in 10 states during three years, ESC reduced single-vehicle crash involvement risk by approximately 41%. Effects were significantly higher for SUVs than for cars. ESC reduced single-vehicle crash involvement risk by 49% for SUVs and 33% for cars. Based on all fatal crashes in the United States during four years, ESC was found to have reduced single-vehicle fatal crash involvement risk by 56%. Again, effectiveness estimates were higher for SUVs than for cars—59% for SUVs and 53% for cars, but these differences were not statistically significant. Multiple-vehicle fatal crash involvement risk was reduced by 32%–37% for SUVs and 25% for cars.

Conclusions. The present study confirms the results of the earlier study. There are significant reductions in single-vehicle crash rates when passenger vehicles are equipped with ESC. In addition, ESC leads to reductions in severe multiple-vehicle crashes".

7. Farmer, C. M. (2004). Effect of Electronic Stability Control on Automobile Crash Risk. Traffic Injury Prevention, 5 (4), 317–325. https://doi.org/10.1080/15389580490896951

Abstract: "Per vehicle crash involvement rates were compared for otherwise identical vehicle models with and without electronic stability control (ESC) systems. ESC was found to affect single-vehicle crashes to a greater extent than multiple-vehicle crashes, and crashes with fatal injuries to a greater extent than less severe crashes. Based on all police-reported crashes in 7 states over 2 years, ESC reduced single-vehicle crash involvement risk by approximately 41 percent (95 percent confidence limits 33–48) and single-vehicle injury crash involvement risk by 41 percent (27–52). This translates to an estimated 7 percent reduction in overall crash involvement risk (3–10) and a 9 percent reduction in overall injury crash involvement risk (3–14). Based on all fatal crashes in the United States over 3 years, ESC was found to have reduced single-vehicle fatal crash involvement risk by 56 percent (39–68). This translates to an estimated 34 percent reduction in overall fatal crash involvement risk (21–45) ".

8. Høye, A. (2011). The effects of Electronic Stability Control (ESC) on crashes: An update. Accident Analysis and Prevention, 43 (3), 1148–1159. https://doi.org/10.1016/j.aap.2010.12.025

Abstract: "The present study is an update of the meta-analysis by Erke (Erke, A., 2008. Effects of Electronic Stability Control (ESC) on accidents: a review of empirical evidence. Accident Analysis & Prevention, 40 (1), 167–173). Results from 12 studies of the effects of Electronic Stability Control (ESC) on the number of different types of crashes were summarized by means of meta-analysis. The results indicate that ESC prevents about 40% of all crashes involving loss of control. The greatest reductions were found for rollover crashes (−50%), followed by run-off-road (−40%) and single vehicle crashes (−25%). These results are however likely to be somewhat overestimated, especially for non-fatal crashes. Multiple vehicle crashes were found to be largely unchanged. Reductions were found for some types of multiple vehicle crashes. Rear-end collisions are unchanged or may increase. Fatal crashes involving pedestrians, bicycles or animals were found to increase as well. ESC was found to be more effective in preventing fatal crashes than non-fatal crashes. ESC is often found to be more effective in Sports Utility Vehicles (SUVs) than in passenger cars. This may be due to differences between drivers of SUVs and passenger cars. The results from meta-analysis indicate that drivers of ESC-equipped vehicles are likely to be safer drivers than other drivers. All the same, ESC may lead to behavioural adaptation in some cases, but it is not likely that behavioural adaptation offsets the positive safety effects. This may be due to a lack of knowledge about ESC".

9. Lyckegaard, A., Hels, T., y Bernhoft, I. M. (2015). Effectiveness of Electronic Stability Control on Single-Vehicle Accidents. Traffic Injury Prevention, 16 (4), 380–386. https://doi.org/10.1080/15389588.2014.948618

Abstract. "Objective: this study aims at evaluating the effectiveness of electronic stability control (ESC) on single-vehicle injury accidents while controlling for a number of confounders influencing the accident risk.

Methods: Using police-registered injury accidents from 2004 to 2011 in Denmark with cars manufactured in the period 1998 to 2011 and the principle of induced exposure, 2 measures of the effectiveness of ESC were calculated: The crude odds ratio and the adjusted odds ratio, the latter by means of logistic regression. The logistic regression controlled for a number of confounding factors, of which the following were significant. For the driver: Age, gender, driving experience, valid driving license, and seat belt use. For the vehicle: Year of registration, weight, and ESC. For the accident surroundings: Visibility, light, and location. Finally, for the road: Speed limit, surface, and section characteristics.

Results: The present study calculated the crude odds ratio for ESC-equipped cars of getting in a single-vehicle injury accident as 0.40 (95% confidence interval [CI], 0.34-0.47) and the adjusted odds ratio as 0.69 (95% CI, 0.54-0.88). No difference was found in the effectiveness of ESC across the injury severity categories (slight, severe, and fatal).

Conclusions: In line with previous results, this study concludes that ESC reduces the risk for single-vehicle injury accidents by 31% when controlling for various confounding factors related to the driver, the car, and the accident surroundings. Furthermore, it is concluded that it is important to control for human factors (at a minimum age and gender) in analyses where evaluations of this type are performed".

10. McCartt, A. T., y Kyrychenko, S. Y. (2007). Efficacy of side airbags in reducing driver deaths in driver-side car and SUV collisions. Traffic Injury Prevention, 8 (2), 162–170. https://doi.org/10.1080/15389580601173875

Abstract. "Objective: o estimate the efficacy of side airbags in preventing driver deaths in passenger vehicles struck on the driver side.

Methods: Risk ratios for driver deaths per driver-side collision were computed for side airbag-equipped cars and SUVs, relative to vehicles without side airbags. Driver fatality ratios also were calculated for the same vehicles in front and rear impacts, and these were used to adjust the side crash risk ratios for differences in fatality risk unrelated to side airbags. Risk ratios were calculated separately for side airbags providing torso-only protection and side airbags with head protection; almost all head protecting airbags also had airbags protecting the torso.

Results: Car driver death risk in driver-side crashes was reduced by 37 percent for head protecting airbags and 26 percent for torso-only side airbags. Car driver death risk was reduced for older and younger drivers, males and females, and drivers of small and midsize cars, and when the striking vehicle was an SUV/pickup or a car/minivan. Death risk for drivers of SUVs was reduced by 52 percent with head protecting side airbags and by 30 percent with torso-only airbags. The effectiveness of side airbags could not be assessed for pickups and minivans due to the small number of these vehicles with airbags involved in crashes.

Conclusion: Side airbags substantially reduce the risk of car and SUV driver death in driver-side collisions. Making side airbags with head protection available to drivers and right front passengers in all passenger vehicles could reduce the number of fatalities in motor vehicle crashes in the United States by about 2,000 each year".

11. Cummings y otros (2002) Association of driver air bags with driver fatality: a matched cohort study, BMJ 2002; 324: 1119

Abstract. "Objective: To estimate the association of driver air bag presence with driver fatality in road traffic crashes.

Design: Matched pair cohort study. Setting: All passenger vehicle crashes in the United States during 1990-2000 inclusive. 51 031 driver-passenger pairs in the same vehicle. Main outcome measures: Relative risk of death within 30 days of a crash.

Results: Drivers with an air bag were less likely to die than drivers without an air bag (adjusted relative risk 0.92 (95% confidence interval 0.88 to 0.96)). This estimate was nearly the same whether drivers wore a seat belt (adjusted relative risk 0.93) or not (0.91). Air bags were associated with more protection for women (0.88 (0.82 to 0.93)), than for men (0.94 (0.90 to 0.99)). Drivers wearing a seat belt were less likely to die than unbelted drivers (0.35 (0.33 to 0.36)). Belted drivers with an air bag were less likely to die than unbelted drivers without an air bag (0.32 (0.30 to 0.34)).

Conclusions: If the associations are causal the average risk of driver death was reduced 8% (95% confidence interval 4% to 12%) by an air bag. Benefit was similar for belted and unbelted drivers and was slightly greater for women. However, seat belts offered much more protection than air bags".

12. Rizzi, M., Strandroth, J., Kullgren, A., Tingvall, C., y Fildes, B. (2015). Effectiveness of motorcycle antilock braking systems (ABS) in reducing crashes, the first cross-national study. Traffic Injury Prevention, 16 (2), 177–183.

Abstract. " Objectives: This study set out to evaluate the effectiveness of motorcycle antilock braking systems (ABS) in reducing real-life crashes. Since the European Parliament has voted on legislation making ABS mandatory on all new motorcycles over 125 cc from 2016, the fitment rate in Europe is likely to increase in the coming years. Though previous research has focused on mostly large displacement motorcycles, this study used police reports from Spain (2006-2009), Italy (2009), and Sweden (2003-2012) in order to analyze a wide range of motorcycles, including scooters, and compare countries with different motorcycling habits.

Methods: The statistical analysis used odds ratio calculations with an induced exposure approach. Previous research found that head-on crashes were the least ABS-affected crash type and was therefore used as the nonsensitive crash type for ABS in these calculations. The same motorcycle models, with and without ABS, were compared and the calculations were carried out for each country separately. Crashes involving only scooters were further analyzed.

Results: The effectiveness of motorcycle ABS in reducing injury crashes ranged from 24% (95% confidence interval [CI], 12-36) in Italy to 29% (95% CI, 20-38) in Spain, and 34% (95% CI, 16-52) in Sweden. The reductions in severe and fatal crashes were even greater, at 34% (95% CI, 24-44) in Spain and 42% (95% CI, 23-61) in Sweden. The overall reductions of crashes involving ABS-equipped scooters (at least 250 cc) were 27% (95% CI, 12-42) in Italy and 22% (95% CI, 2-42) in Spain. ABS on scooters with at least a 250 cc engine reduced severe and fatal crashes by 31% (95% CI, 12-50), based on Spanish data alone.

Conclusions: At this stage, there is more than sufficient scientific-based evidence to support the implementation of ABS on all motorcycles, even light ones. Further research should aim at understanding the injury mitigating effects of motorcycle ABS, possibly in combination with combined braking systems".

13. Bahouth, G. (n.d.). Real World Crash Evaluation of Vehicle Stability Control (VSC) Technology (VSC). 49.º Annual Proceedings of the Association for the Advancement of Automotive Medicine

Abstract: "This study quantifies the effect of Vehicle Stability Control (VSC) in reducing crash involvement rates for a subset of vehicles in the US fleet. Crash rates for a variety of impact types before and after VSC technology was implemented are compared. Police-reported crashes from six available US state files from 1998–2002 were analyzed including 13,987 crash-involved study vehicles not equipped with the technology and 5,671 crashes of vehicles equipped with VSC as a standard feature. Overall, an 11.2% (95% CI: 2.4%, 21.1%) reduction in multi-vehicle frontal crash involvement was identified for VSC-equipped vehicles. A 52.6% (95% CI: 42.5%, 62.7%) reduction in single-vehicle crash rates was found".

14. Kahane CJ. Lives Saved by Vehicle Safety Technologies and Associated Federal Motor Vehicle Safety Standards, 1960 to 2012 – Passenger Cars and LTVs. Report No DOT HS. 2015.

Abstract: "NHTSA began in 1975 to evaluate the effectiveness of vehicle safety technologies associated with the Federal Motor Vehicle Safety Standards (FMVSS). By June 2014, NHTSA had evaluated the effectiveness of virtually all the life-saving technologies introduced in passenger cars, pickup trucks, SUVs, and vans from about 1960 up through about 2010. A statistical model estimates the number of lives saved from 1960 to 2012 by the combination of these life-saving technologies. Fatality Analysis Reporting System (FARS) data for 1975 to 2012 documents the actual crash fatalities in vehicles that, especially in recent years, include many safety technologies. Using NHTSA's published effectiveness estimates, the model estimates how many people would have died if the vehicles had not been equipped with any of the safety technologies. In addition to equipment compliant with specific FMVSS in effect at that time, the model tallies lives saved by installations in advance of the FMVSS, back to 1960, and by non-compulsory improvements, such as pretensioners and load limiters for seat belts. FARS data has been available since 1975, but an extension of the model allows estimates of lives saved in 1960 to 1974.

A previous NHTSA study using the same methods estimated that vehicle safety technologies had saved 328,551 lives from 1960 through 2002. The agency now estimates 613,501 lives saved from 1960 through 2012. The annual number of lives saved grew from 115 in 1960, when a small number of people used lap belts, to 27,621 in 2012, when most cars, light trucks, and vans were equipped with numerous modern safety technologies and belt use on the road achieved 86 percent".

PART III SCHEDULES

Schedule III-1. Analysis Model

In every economy there are a number of H households. Households use the vehicle fleet whose technological state is represented by Γ_0. Thus, for a country, given the technological status or penetration of the fleet, it is represented by the proportion of cars that have the different technologies. For example, the percentage of vehicles that have safety belts, ABS, ESC, etc.

In the economy, the current state of the fleet Γ_0 generates a number of deaths m_0 and injured l_0 as a consequence if road traffic crashes. When vehicle safety regulations change in a country, this creates changes in the penetration of fleet technologies, and this in turn produces effects on the economy through multiple mechanisms. The analysis takes as its focal point what happens to the group involved closest to the effects of the regulations. Each of the parts involved has a group of channels through which they are affected. The parts involved that are modeled are households, the vehicle manufacturing sector and its auto part manufacturers, the government and healthcare companies.

In the economy, there are n industries, where each industry i competitively produces X_i, using the amount of labor L_i, the capital stock K_i and intermediate inputs from other industries j. The supply of intermediate inputs to industry i by industry j is represented as X_{ij} for $j = 1..n$. Each of the sectors can substitute the use of factors, but not the inputs.

It is assumed that the production of the economy is carried out in a hierarchical way as represented below. First, value added is produced in each sector, and then the gross value of the economy's output is decided.

Thus, the value-added production of each sector i of the economy can be represented by the function:

$$V_i = V_i(K_i, L_i)$$

so the gross value production function of production is represented as:

$$X_i = F^i\left(V_i, X_{ij}, a_{ij}\right) \ with\, j = 1..n \qquad (1)$$

Therefore, production in the economy is represented by a nested function where the value added is determined by a function with constant elasticity of substitution, and the use of inputs is determined by a Leontief production function.

Assuming that companies try to maximize their profit, the demand for labor and capital factors in each sector can be derived as a function of the relative prices of the productive factors,

$$l_i = l_i\left(\frac{w}{r}\right) \ i = 1..n \qquad (2)$$

and,

$$k_i = k_i\left(\frac{w}{r}\right)\ i = 1..n \tag{3}$$

Assuming there is full employment in the economy, and taking into account that the production function has constant returns of scale, the domestic prices of the economy are obtained as the natural prices, or unit costs of the system, that is

$$p_i = \sum_{i=1}^{n} a_{ij}p_i + wl_i + rk_i \tag{4}$$

Whose solution in matrix terms can be expressed as:

$$p = (I - A)^{-1}(wl + rk) \tag{5}$$

Note that all system prices are expressed as a function of the technological characteristics of the economy and factor prices.

The total income of the economy depends only on the use of internal factors,

$$Y = w\bar{L} + r\bar{K} \tag{6}$$

where $\bar{L}$ and $\bar{K}$ represent the total offer of work and available capital stock respectively. Income Y is used by households and applied to different goods and services according to the distribution that a linear expenditure function performs.

Finally, assuming that all markets are balanced, it is possible to express the following identity:

$$X_i = \sum_j X_{ij} + F_i + E_i - M_i \tag{7}$$

where F_i is the expenditure made by households and the goods i and E_i and M_i are the exports and imports which correspond to the goods i.

Taking into account the definition made above:

$$X = [I - A]^{-1}(F + E - M) \tag{8}$$

Although the operation of the domestic demand is a key part of the model, and will be developed more carefully later, at this stage a simplified functional form will be assumed to advance with the intuition of the model.

Thus, the household expenditure function is assumed to be derived from solving a maximization problem with Cobb-Douglas utility functions as will be explained later. Hence, in a very simplified representation of the demand function this can be expressed as:

$$p_i F_i = \epsilon_i Y \tag{9}$$

where p_i represents the price and ϵ_i represents the proportion of income of the household spent on goods i. This way, demand for all sectors of the economy can be expressed in matrix form as $F = \hat{p}^{-1}\epsilon Y$.

Using the above equations, it can be expressed that the total demand for labor $\overline{L}$ is:

$$\overline{L} = l'[I - A]^{-1}(\hat{p}^{-1}\epsilon Y + E - M) = l'[I - A]^{-1}(\hat{p}^{-1}\epsilon(w\overline{L} + r\overline{K}) + E - M) \tag{10}$$

And likewise, the total demand for capital is determined by:

$$\overline{K} = k'[I - A]^{-1}(\hat{p}^{-1}\epsilon Y + E - M) = k'[I - A]^{-1}(\hat{p}^{-1}\epsilon(w\overline{L} + r\overline{K}) + E - M) \tag{11}$$

To characterize the equilibrium, it is important to note that constant returns to scale are assumed. In this context, the initial equilibrium of the economy is characterized by Ω_0 which is defined as:

$$\Omega_0 \equiv \{p_0^*, w_0^*, r_0^*, l_0^*, k_0^*\}$$

where p_0^* is the unit price vector, w_0^* the equilibrium wage, $r_0^*$the interest rate and the labor and capital allocation vectors are denoted by l_0^*y k_0^* respectively.

In the equilibrium Ω_0, all the equations presented above are solved simultaneously, representing the situation in which all the agents of the economy optimize their decisions, subject to the initial technological penetration Γ_0 and the amount of capital and labor added $\overline{K}_0$ and $\overline{L}_0$ of the equations (10) and (11) respectively.

of the UN Regulations

$$\Delta n = n_1 - n_0$$

It is important to note that each country has a different Δn value. This is because although the set of indications n_1 is constant for each country, as it is determined by the UN Regulations of WP.29, the value of n_0 , i.e. the rules in force in each country, are different in each of the countries. In each case, the change in regulations generates a new state of technological penetration, which is denoted by Γ_1.

In part II of this report, a number of deaths and a number of injuries are associated with each technological state. Thus, for example, the state Γ_0 is associated with a number of deaths m_0 and a number of injured l_0. Likewise, the number of deaths m_1 and the number of injured $\mathrm{l}_1$are associated to the technological penetration Γ_1.

Effects on sectorial demand

In the equilibrium Ω_0, the households solve the following problem:

$$\max_{q} U = \phi \prod_{i=1}^{n} \tilde{q}_i^{\beta_i}$$

Subject to $\sum_{i=1}^{n} \beta_i = 1$ and the budget restriction of the entire economy. The values of β_i and $\tilde{q}_i$ that solve the system are obtained by calibrating the actual data obtained from the input -output matrices obtained with ECLAC data.

The expenditure associated with each death and injury in each country was estimated using information from each country. Although there is a wide variety of injuries which generate different costs, a representative average cost was assumed in each case. Thus, it is assumed that a death or an injury generates expenses in the following two sectors of the economy:

	Deaths	Injured
Healthcare sector	$e_{m,1}$	$e_{l,1}$
Other services	$e_{m,2}$	$e_{l,2}$

Thus, if with the technological penetration Γ_1 m_1 deaths are generated, then the total cost of deaths in the healthcare sector will be $m_1 * e_{m,1}$, whereas the cost of injured in the same sector will be $l_1 * e_{l,1}$.

Then, taking into account that since the technological penetration Γ_1 represents the state in which the entire vehicle fleet adopts the technology suggested in this report, it must always be $m_1 < m_0$.

As a consequence of the new technological penetration Γ_1 now households redistribute their expenses. To model this reallocation, it is assumed that from the initial equilibrium Ω_0, where households spend $\tilde{q}_i$, they redistribute their surplus income as follows.

First, it is assumed that, with the new technological penetration, the final demand function of households is characterized by a linear system of expenses. There is a sectoral demand, which depends on prices according to the following problem that consumers solve:

$$\max_{q} U = \phi \prod_{i=1}^{n} (q_i - \gamma_i)^{\beta_i}$$

Always taking into account that

$$\sum_{i=1}^{n} \beta_i = 1, (q_i - \gamma_i) > 0 \text{ y } \beta_i > 0.$$

Hence, considering the economy-wide budget constraint faced by households, the demand function for each sector i is determined by

$$p_i q_i = p_i \gamma_i + \beta_i \left(Y - \sum_{j=1}^{n=40} p_j \gamma_j \right) \; for \;\; i = 1..40$$

However, to introduce the effect of redistributing expenses, the household demand system will be specified by the following forty equations,

$$p_1q_1 = p_1\tilde{q}_1 - (m_0 - m_1) * e_{m,1} - (l_0 - l_1)e_{l,1} + \beta_1\left(Y + (1-s)g - \sum_{j=1}^{n=40} p_j\tilde{q}_j\right)$$

$$p_2q_2 = p_2\tilde{q}_2 - (m_0 - m_1) * e_{m,2} - (l_0 - l_1)e_{l,2} + \beta_1\left(Y + (1-s)g - \sum_{j=1}^{n=40} p_j\tilde{q}_j\right)$$

$$p_iq_i = p_i\tilde{q}_i + \beta_1\left(Y + (1-s)g - \sum_{j=1}^{n=40} p_j\tilde{q}_j\right) for\ i = 3..40$$

with

$$g = (m_0 - m_1) * \left(e_{m,1} + e_{m,2}\right) + (l_0 - l_1) * \left(e_{l,1} + e_{l,2}\right)$$

where $(m_0 - m_1)e_{m,1}$ is the amount of money that families stop spending on things related to a fatality thanks to the new technology, $(l_0 - l_1)e_{l,1}$ is the amount of money that is no longer spent on health problems that used to result from the old technology, g is the amount of money not spent on the two reference sectors thanks to the new technology, and finally, s is the households' savings rate.

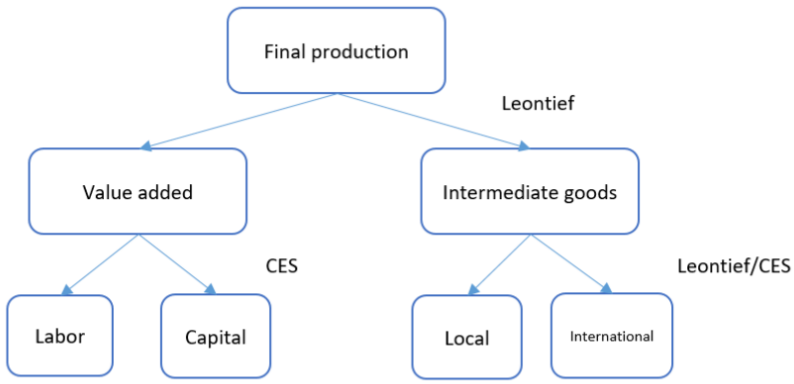
Effects on the supply

The production of companies and sectors is represented by a tree of technology and nested functions, as shown in Figure A1. The tree can be read from top to bottom, indicating that the gross output of the economy is the sum of value-added production plus the production of intermediate goods.

The combination of intermediate goods and final goods is decided by a Leontief production function that is obtained from the input-output matrix. Going down the tree, it can be seen that the allocation of labor and capital is decided by a function that has constant elasticity, and this function is conditioned by the technology.

Finally, the decision to incorporate intermediate goods is modeled using two technologies. For the sectors that are not affected, a Leontief function is used, while for other sectors.

Figure A1. Production structure



When the technology penetration changes, three important effects occur on this function. First, there is an increase in the amount of labor, second, capital increases due to increased savings, and third, factor productivity rises.

First, when the new technological penetration Γ_1 is put into place, the number of working hours available increases, as there are less deaths, and people who would have been injured in a different scenario can work full time. Therefore, the supply of annual hours available in the economy is altered with regards to equilibrium Ω_0 as follows:

$$\Delta L = (m_0 - m_1)45 * 52 + (l_0 - l_1)\ 3 *\ 52$$

where $(m_0 - m_1)$ y $(l_0 - l_1)$ is the difference in the deceased and injured due to the new technological penetration. 52 is the number of weeks in a year, 45 are the weekly hours of work, and 3 is the average number of hours assumed to be lost per week by a person who is injured. Note that human capital is assumed to be homogeneous that is why all people count equally.

Second, as developed in the previous section, households save a fixed proportion of their income. Therefore, the capital of the economy will increase in the new equilibrium in the amount

$$K_1 = K_0 + sg$$

where, as explained above, g is the expenditure avoided by families as a result of better technology. It is assumed that this increase in capital is distributed evenly across all sectors of the economy.

Third, as pointed out by Howitt (Howitt 2005) and Van Zoon and Muyken (van Zoon y Muysken 2005), the decrease in crashes is translated into improvements in health which in turn provide positives changes in productivity, learning capabilities, life expectancy, ability to be creative, and income distribution.

To integrate this effect, we will assume that individuals' wages are an approximate measure of their productivity, following the logic of the theory of Efficiency Wages (Carl Shapiro and Joseph Stigliz (1984)) to make an approximation of the productivity effect. The change in productivity is associated with the contribution that the wages of the deceased and injured make to the total wage bill. Thus, productivity growth $\frac{\Delta\rho}{\rho}$ in all sectors of the economy will be determined by,

$$\frac{\Delta\rho}{\rho} = \frac{\Delta L}{L} = \frac{(m_0 - m_1)44 + (l_0 - l_1)\ 3}{L}\frac{w_i}{\overline{w}}$$

where ΔL is the number of L's that are additionally worked as a result of the new technology, and L is the number of hours that are worked in the year. What's more, since people who have vehicles have a higher salary than the average for the entire population, w_i is added as an estimate of the salary of households that have a vehicle, and $\overline{w}$ is the average economy wage. The value of w_i was approximated by the 75th percentile of the wage distribution.

Finally, the introduction of the new technology represents a change in production costs that is assumed to be fully absorbed by producers. That is, these price changes are not transmitted to prices, as noted in the main body of this work, but are absorbed by the profits of the vehicle production companies. To obtain this effect, it is assumed that there is a change in sectoral transactions and

$$Z_{ij}^1 = Z_{ij}^0 + C^1$$

where C^1 is the approximate cost of the technology penetration in vehicles. This value is approximated by $C^1 = c * y$, where c is the marginal unit for adding the required technology and y is the total production of new vehicles in the country under study.

With all the modifications made to the economy's demand and supply, the new equilibrium is calculated

$$\Omega_1 \equiv \{p_1^*, w_1^*, r_1^*, l_1^*, k_1^*\}$$

and the changes in growth generated in the economies are reported as the differences obtained between the equilibria Ω_1 and Ω_0.

Hence, for example, the difference in Gross Domestic Product growth is reported as

$$\frac{\Delta PI}{GDP} = \frac{GDP(\Omega_1) - GDP(\Omega_0)}{GDP(\Omega_0)}$$

where $GDP(\Omega_x)$ is the GDP value obtained in the equilibrium x.

Treatment of International Trade

International trade effects are obtained by the multi-sector and multi-country input-output tables. These tables represent an integrated set of matrices that show the balance between the supply and use of goods and services (products). By definition, the input-output tables allow us to appreciate the components of supply, intermediate demand, final demand and the value-added table.

From the input-output approach it is possible to analyze in detail the production process in terms of the input (product) requirement of a sector, from others at the national level, or internationally (in the case of imported intermediate inputs). In turn, the products generated by an economy can be exported to other countries, forming productive integration links, also by this channel.

The starting point for the calculations is the matrix of multiregional inputs and outputs available for 11 Latin American countries. More information on the use of input-output matrices can be found in Miller and Blair (2009). The information for each country is available for 40 economic sectors. This means that matrix Z of transactions is a matrix of 440 x 440 economic sectors.

The variation of the value added for countries is obtained as follows:

$$\Delta V = v * (I - A)^{-1} * \Delta f$$

where A is the matrix of multiregional technical coefficients of 440 x 440 sectors and $(I - A)^{-1}$is Leontief's multiregional matrix of multipliers.

The variations of final demand are represented by Δf. This variations are calculated as $\Delta f = \left(f(\Omega_1) - f(\Omega_0)\right)$ which is a vector of 440 rows that contain a change in final demand recorded in the 40 sectors of each of the 6 economies under study in the equilibria 1 and 0. In calculating this vector of differences in final demand, it is important to bear in mind that for Bolivia, Chile, Paraguay, Peru and Venezuela there is no variation and only the local final demand to each economy is considered.

Finally, v is the vector of 440 rows with information on the technical coefficients of value added for each of the 11 economies available in the tables.

Information on changes in labor and taxes was obtained using the appropriate technical coefficient vectors in each case.

Schedule III-2. Bibliographic Review

The bibliographic review of this report is organized in two appendices that provide substance to all the elaboration carried out in the main body of this work. This appendix presents the literature reviews that address the content developments, while Appendix 4 presents a method review.

Three important analyses are presented in this appendix: first, the effect of health improvements on the economy, second, the effect of vehicle-generated environmental pollution on the economy, and third, the effect of regulations on trade patterns.

Economic Impact of the Improvements in Health

The works of Mankiw, Romer and Weill (Mankiw, Romer y Weil 1992) Howitt (Howitt 2005) and van Zoon and Muysken (van Zoon y Muysken 2005) present a rich overview of the mechanisms that link health status and economic growth, or increased value added. Each of these models represents theoretical paradigms of economic growth.

Mankiw et al (Mankiw, Romer y Weil 1992) show, within the framework of neoclassical growth theory, the importance of human capital in explaining the difference in per capita product among countries. Their results are framed in neoclassical theory, so that increasing people's health as a component of human capital generates a change in the level of product per capita, but does not generate long-term growth, since this is only determined by the expansion of technology.

Thus, understanding how healthier human capital generates economic growth requires paying attention to models of endogenous growth.

In this framework, Howitt (Howitt 2005) develops a model with Schumpeterian foundations showing that there can be two long-term equilibria according to the characteristics of each economy. In one equilibrium, the economies grow at the same rate in the long term, and there is convergence, while in the other equilibrium the economies stop growing and in the long run their growth rate is zero. The state of health of the people living in the economy of reference will be conditioned by the equilibrium of the economies. Thus the author identifies six possible channels: (i) productive efficiency, (ii) increase in life expectancy, (iii) learning capacity, (iv) creativity, (v) capacity to adapt to multiple technological changes, and (vi) improvements in economic inequality due to improvements in people's health status.

Based on endogenous growth models (Lucas 1988), where what matters is the existing knowledge in the economy, health can have effects on growth through four possible channels: (i) health has effects on the quality of work services, (ii) there is an effect on the capacity to accumulate knowledge, and when health is not good, the capacity to accumulate knowledge is reduced, (iii) the economy's savings increase when people think they will live a longer life, therefore investments will increase and finally (iv) there is an increase in the average age of the population and this can have important effects on developing countries, due to important changes in the state's expenditure structures.

Work summary	Effect	Households	Companies	Government
(Ashraf, Lester y Weil 2009)	Health increase	Productivity increase		GDP increase
(Channing y Lewis 2000)	Elimination of diseases (AIDS)	Productivity increase	TFP increase	Decrease in health care spending
(Aísa y Pueyo 2004)	Life expectancy increase	Increase in savings	Increase in company productivity	Increase in public health care spending
(Becker, Philipson y Soares 2005)	Life expectancy increase	Decrease in inequality		
(Bell, Devarajan y Gersbach 2003)	Effect of AIDS	Drop of people' productivity	Destruction of human capital	
(Bloom, y otros 2010)	Effect of health (life expectancy)	Increase of savings and investment in human capital	Productivity increase/Accumulation of capital	GDP increase
(Bloom, y otros 2010)	Increase of life expectancy and international trade	Decrease of fertility	Increase in the working-age population	
(Finlay 2006)	Life expectancy	Increased investment in schooling/ Income		
(Gyimah-Brempong y Wilson 2004)	Increase in health human capital			Increase in income per capita
(Jamison, Lau y Wang 2003)	Increased survival	Income and health increase		
D. Weil; S. Kalemli-Ozcan & H Ryder	Decrease in mortality due to more education	Increased income and reduced mortality		
(Murphy y Topel 2006)	Increased willingness to pay for health care	Reduced mortality, increased longevity		GDP increase/Increase of health care spending
(Weil 2007)	Health increase	Income increase	Increased human and physical capital accumulation	GDP increase

(Zhang y Zhang 2005)	Life expectancy increase	Reduces fertility / Increases schooling and savings		GDP increase

Regulations and International Trade

There is an extensive literature on the effects of regulations and trade standardization between countries. Although the literature does not have definitive results on the final effects of trade, it does provide clues that help build the most likely scenario that can be expected after the implementation of the UN Regulations.

Swann's work (Swann 2010) helps to clearly understand the richness of the problem by providing a conceptual framework where it is first important to distinguish the difference between an international standard and a regulation.

A standard is treated as 'international' if it is common to a group of countries or regions (e.g., Latin American countries), regardless of whether the standard is proposed by an international organization or not. Some studies of bilateral trade between countries A and B consider a standard as 'international' if it is harmonized in both countries, without the need to consider whether the standard is endorsed by a supranational organization or not.

Trade officials and regulators are used to making a strict separation between standards and regulations. The distinction between the two is that compliance with standards is voluntary, while compliance with technical regulations is mandatory by law. Much of the existing literature has tended to discuss both together. In fact, there is a view that many so-called "voluntary" standards are not really voluntary, even if they are not legal requirements, they are commercial imperatives.

This review will develop the evidence related to regulation and trade, and if they are considered standards, it will do so when they are factually mandatory.

Chen and Mattoo (Chen y Mattoo 2004) estimate a gravitational model of bilateral trade between pairs of countries. They use data from 28 OECD and 14 non-OECD countries covering 3-digit SITC product categories from all sectors of the economy.

They create "standard" measures from data on Mutual Recognition Agreements (MRAs) and harmonization agreements. MRA variables are simple binary variables that indicate whether there is a (1) or no (0) MRA between two countries (e.g., I and J) for product R in year T. Several different MRA variables are constructed to obtain MRAs with and without associated rules of origin. The harmonization variables count the total number of harmonization directives affecting trade between the two countries (I and J) for product R in year T. Several different MRA variables are constructed to obtain MRAs with and without associated rules of origin.

The authors find that such harmonization agreements can increase trade between participating countries (A and B in the diagram above) but will not necessarily increase trade with other countries (C and D). They find that harmonization increases exports from excluded developed countries (C in the previous diagram) to the region, but reduces exports from excluded developing countries (D) to the region. They explain this difference as follows. The harmonized standard in the region is likely to be quite strict compared to what country D is used to, and as a result, any costs of harmonization in the form of economies of scale are offset by the increased costs of complying with a stricter standard.

In contrast, for those countries that are already familiar with strict standards (C, for example), the benefits of harmonization outweigh the costs. Therefore, the net effect of harmonization in a region is to increase exports of C and reduce exports of D to the region.

Vancauteren and Weiserbs (Vancauteren y Weiserbs 2005) and Henry de Frahan and Vancauteren (Henry de Frahan y Vancauteren 2006) analyze the effects on intra-EU trade of regulatory harmonization produced in the EU.

Vancauteren and Weiserbs analyze the effects of the harmonization of technical regulations by the EU, as part of a broad application of the gravitational model to intra-community trade in manufacturing. Their data on technical regulations come from the European Commission (1998). This indicates, at 3-digit level of NACE, whether trade is affected by technical regulations and it also shows the main approach used by the Commission to remove such barriers. From this data, they construct a trade-weighted coverage variable that measures the proportion of a country's exports that satisfy the EU regulatory harmonization. This variable is standardized to measure the degree to which a country shows greater than average compliance with EU harmonization. Using data for total manufacturing and for the period 1990-1998, they estimate a gravity model for intra-EU trade that includes this coverage variable. The results of their regression find that the harmonization of EU regulations has played a very positive and statistically significant role in explaining the growth of intra-EU trade in manufacturing.

Henry de Frahan and Vancauteren estimate a gravitational model of bilateral trade at a total of 1284 8-digit products taken from 10 NACE subsectors covering food products. The data refer to 10 importing countries and 14 exporting countries in the EU. They calculate the regulatory variables from a very detailed database on the harmonization of technical regulations. In the database, TBT harmonization is described by a binary variable. For each product, it takes the value 1 if the harmonization rules apply to bilateral trade in that product, and 0 otherwise. The variable is also set to 0 if one or more of the following conditions are met: (i) harmonization does not apply and countries maintain their own national regulations, (ii) national regulations are not considered important and/or (iii) mutual recognition is observed. Binary variables are aggregated to form export-weighted trade coverage indices that are used in their model as a measure of harmonization.

Their regression results find that these harmonization variables have positive and significant coefficients for overall intra-community trade in food products and, at a more disaggregated level, for trade in 9 of the 10 food product categories. They conclude that the harmonization of food regulations has increased intra-community trade in all food products in approximately 2⁄3, and in fruits and vegetables in approximately 1⁄3 during the period 1990-2001.

The study led by Baller (Baller 2007) examines bilateral trade in two sectors, telecommunications equipment and medical devices, between 26 OECD countries and 22 non-OECD countries. It estimates a gravitational model using trade data at the 3-digit level. Baller's database contains information on 8 MRAs relevant for medical devices and 14 MRAs relevant for telecommunication equipment. It also contains information on 22 EU harmonization agreements and 19 ASEAN harmonization agreements. It constructs several variables to represent the relevance of MRAs and harmonization agreements for bilateral trade between a particular pair of countries. The MRA variable is a binary measure that indicates whether two countries have an MRA with each other at a given time (1) or not (0). The main measure of harmonization is a binary variable that takes value 1 if two countries have a relevant harmonization agreement at a given time. It also creates two other binary variables to measure whether: (i) country A is part of a harmonizing region and C is not, and C is an OECD country; (ii) country A is part of a harmonizing region and D is not, and D is not an OECD country.

Baller's results indicate that MRAs have a positive influence on export probabilities and trade volumes for these countries in the MRA. The results for harmonization are not as clear. Baller distinguishes three cases. First, the extent of harmonization among partners for a harmonization agreement (A↔B) does not appear to have a significant effect on their model. Second, third party OECD countries, marked as C in Figure 3, benefit from regional harmonization agreements through increased exports (C → A). Thirdly, third developing countries, marked as D in Figure 3, do not appear to benefit from regional harmonization agreements through increased exports (D → A).

Schedule III-3. Data

A large number of information sources for each country was used for this project. In this section, a summary of the most important sources is provided, and at the same time a more detailed explanation will be given of the technique used to update the information in the input-output matrices between the countries.

First, the main sources used for Argentina were:

Source	Data
Argentine Association of Automotive Manufacturers (ADEFA)	Information on the vehicle fleet
Association of Argentine Component Manufacturers (AFAC)	Data on the vehicle fleet
International Labor Organization (ILO)	Labor market sources
International Organization of Motor Vehicle Manufacturers (OICA)	Data on vehicle production and sales
WHO	Car crashes
Argentine Business Council for Sustainable Development (CEADS)	Information on pollution
Comtrade	International trade
EORA Project	Input-output matrices
Argentine Ministry of Infrastructure	Traffic laws
World Bank	Country's GDP
Ministry of Environment and Public Space	Information on pollution
National Civil Aviation Administration (ANAC)	Production and sales in the automotive sector

The most important sources for Brazil are listed below:

Ministerio De las Cidades	Data on the vehicle fleet
Brazilian Ministry of Transport	Data on the vehicle fleet
Brazilian Association of Automotive Manufacturers (ANFAVEA)	Statistics on the vehicle fleet
ILO	Labor market sources
International Organization of Motor Vehicle Manufacturers (OICA)	Data on vehicle production and sales
WHO	Car crashes

Brazilian Department of Traffic (DENATRAN)	Car distribution
World Bank	Country’s GDP
Institute of Energy and Environment	Information on pollution
EORA Project	Input/output matrices
Comtrade	International trade
ANAC	Production and sales in the automotive sector

For Colombia:

EORA project	Input-output matrices
Comtrade	International trade
ILO	Labor market sources
OICA	Data on vehicle production and sales
WHO	Car crashes
World Bank	Country’s GDP
Comunidad Andina (Andean Community)	Automotive market
National Association for Sustainable Mobility (ANDEMOS)	Automotive sector
Secretary of Mobility	Vehicle fleet
Institute of Hydrology, Meteorology and Environmental Studies (IDEAM)	Information on pollution
Colombian Ministry of Transport	Automotive sector
ANAC	Production and sales in the automotive sector

For Ecuador:

EORA project	Input-output matrices
Comtrade	International trade
ILO	Labor market sources
OICA	Data on vehicle production and sales
WHO	Car crashes
World Bank	Country’s GDP
National Traffic Agency	Information on crashes
National Institute of Statistics and Census (INEC)	Automotive sector
Association of Automotive Companies of Ecuador (AEDAE)	Information on the automotive industry
Ecuadorian Ministry of	Information on pollution

Environment	
ANAC	Production and sales in the automotive sector

For Mexico:

EORA project	Input-output matrices
Comtrade	International trade
ILO	Labor market sources
OICA	Data on vehicle production and sales
WHO	Car crashes
World Bank	Country's GDP
INEGI	Information on crashes
AMIA	Information on the automotive industry
National Injury Observatory	Information on crashes
National Institute of Ecology and Climate Change (INECC)	Information on pollution
National Institute of Statistics and Geography (INEGI)	Vehicle fleet
Mexican Ministry of Economy	Information on the automotive industry
ANAC	Production and sales in the automotive sector

And finally, for Uruguay:

EORA project	Input-output matrices
Comtrade	International trade
ILO	Labor market sources
OICA	Data on vehicle production and sales
WHO	Car crashes
World Bank	Country's GDP
Management of Montevideo	Information on crashes
Center for Innovation in Industrial Organization (CINOI)	Information on pollution
Uruguayan Automobile Trade Association (ACAU)	Automotive sector
Uruguayan Ministry of Transport and Public Works (MTOP)	Vehicle fleet
Investment and Export Promotion	Automotive sector
ANAC	Production and sales in the automotive sector

The data framework developed by ECLAC and IPEA (CEPAL 2016) is used to model the interaction between the countries under analysis. Input and output tables were compiled and interconnected for 10 Latin American countries. The information in the matrices was put together for 40 economic sectors and information was collected from Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Venezuela and Uruguay.

The process of constructing the Latin American matrix has meant the development of different phases, along with the reconciliation of many sources of information. The final result of this effort is a matrix of 40 by 40 products, mainly for 2005, along with the information on imports and exports that were made by sector to each of the different countries.

Although it was complete and of excellent quality, the use of ECLAC information had two challenges. On the one hand, the information was based on 2005, and on the other hand, the data model did not include Mexico. To reduce these drawbacks, an additional database was used to reinforce the results.

The database used for the correction of the two previous problems corresponds to those provided by the EORA project (Lenzen, Kanemoto, y otros 2012) and (Lenzen, Moran, y otros 2013). The EORA project was born out of the need to compile the existing multi-regional input-output matrices (MRIO) since these types of matrices have a great deal of flexibility in different areas such as the environment and the economy.

The construction of the EORA base is composed of different sources such as:

1. Aggregated Input-Output matrices corresponding to different countries, provided by their own data processing sources.
2. Compilation of input-output matrices from Eurostat 2011, IDE-JETRO 2006 and the OECD 2009.
3. Aggregated database of the national accounts of countries provided by the United Nations.
4. Official United Nations' databases.
5. International trade database created by Comtrade and the United Nations.
6. International trade base provided by Servicetrade.

ECLAC information was developed by decomposing the economy's information into the following 40 sectors:

1	Agriculture and forestry	21	Non-metallic mineral products
2	Hunting and fishing	22	Iron and steel
3	Mining (energy)	23	Non-ferrous metals
4	Mining (no energy)	24	Manufactured metal products (except machinery and equipment)
5	Meat and derivatives	25	Machinery and equipment (excluding electrical machinery)
6	Milling, bakeries and pastries	26	Office equipment (including computer

			equipment)
7	Sugar and confectionary products	27	Machinery and electrical appliances
8	Other food products	28	Radio, television and telecommunications equipment
9	Drinks	29	Medical equipment and optical and precision instruments
10	Tobacco products	30	*Motor vehicles, trailers and semi-trailers*
11	Textiles	31	Aircraft and spacecraft
12	Clothing	32	*Other transport equipment*
13	Footwear	33	Other manufacturing N.E.C.; recycling (furniture incl.)
14	Wood and wood products and cork	34	Electricity and gas
15	Wood pulp, paper, printing and publishing	35	Construction
16	Coke, refined oils and nuclear fuels	36	Transport
17	Basic chemicals	37	Mail and telecommunications
18	Other chemicals (pharmaceuticals excl.)	38	Finance and insurances
19	Pharmaceuticals	39	Services to companies of all types
20	Rubber and plastic products	40	Other services

First, the data from Mexico provided by EORA were incorporated to include the country into the ECLAC database.

Secondly, information from the edges of the entire EORA matrix for 2015 was used.

With this information, the method of Crossed Entropy was used to update and make all the matrices coherent.

Schedule III-4. Strengths and Weaknesses of the Methodological Strategy

As described in the work of the WHO (World Health Organization 2009) the cost of illness approach introduced by Rice in different formats (Rice, Estimating the Cost of Illness 1966) has been the most widely disseminated method of conducting health economic impact studies.

In this method, the specific consequences of a disease are divided into direct and indirect costs. The direct costs are the expenses incurred due to the disease (including medical care, travel costs, etc.), while the indirect costs are the income not received as a result of the factors that were not used as a consequence of the disease. In particular, most works have attempted to obtain income not received from work not carried out. They did not attempt to measure the costs of pain and suffering by describing them, as these would be intangible costs.

Once the direct and indirect costs have been identified and calculated, they must be added to provide the overall cost that the disease imposes on society. The overall cost is expressed as a percentage of the GDP for the period over which the analysis is being carried out.

This technique has the advantage of being simple, but it presents a large number of conceptual problems that must be highlighted when using it. First, health expenses are necessary to produce income that is then attributed as not perceived. To put a very simple case, in order for a doctor's income to be produced, crashes are necessary. Therefore, there is a double attribution when these two concepts are added together. Secondly, there is no common agreement when it comes to selecting which concepts should be added as direct costs and which are the sources of unearned income that should be allocated as indirect costs. For example, the works of Rice, Hodgon and AN (Rice, Hodgson y AN 1985) consider that the definition of direct costs should be expanded to include spending on medical research, training and capital investment in medical equipment. Costs incurred outside the health sector, e.g., travel to seek care, special foods, equipment, and clothing, should also be taken into account to the extent that they can be measured. Costs of modifying homes and cars, when necessary, should also be included.

In this report, the method followed is fundamentally based on the possibility of expressing the economic impact as a change in the Value Added generated by the country.

The model is built from the preferences and restrictions of individual agents (households, businesses, government, etc.) and is accumulated to achieve the simultaneous macroeconomic equilibrium of market compensation (set of prices that ensures that demand is equal to supply in all sectors).

The impact of the introduction of new security technologies is modeled as an unexpected change in the crashes affecting the supply of labor and demand for services.

The amount of interest used to represent the impact has to do with market values, which in many cases were not obtained due to the crashes. The model provides information on many components of the economy such as labor market, total production, household income and wages.

One of the most important disadvantages of this method is the data requirement. In principle, it is necessary to construct a social accounting matrix to begin the analysis. The social accounting matrix has as its most important input the input-output matrices that describe the general structure of the economy.

In addition to this structural information, it is necessary to add values to a set of parameters that characterized the scenarios with and without the treatment effect. An important component of this second group of parameters to be adjusted is the information with the epidemiological characteristics of the crashes.

The great advantage of this method is that it obtains cross-sectional effects that can be completely ignored when using other methods.

In addition to the information problems associated with the method, there are also problems related to the sensitivities of the parameters and specifications adopted to perform the modeling. Considerable technical expertise is required to obtain results. This technical requirement sometimes becomes a limitation for its use and application, compared to other methods that are considerably simpler and less intensive in the use of data.

Another problem is related to the computer requirement for the solution of equilibria. The model used in this chapter has more than 700 equations. Finding the solution to this system of equations requires extensive computer capacity.

As mentioned above, a fundamental requirement of this method is to have input-output matrices. This information is not always available with the desired level of detail and therefore mechanisms must be used to complete the data. Sometimes these mechanisms use techniques that take advantage of the accounting characteristics of the data. While in other cases the lack of data means that historical data must be used to complete the data.

In many cases, the lack of country-specific parameters leads to the adoption of parameters from similar countries, and this affects the quality of the results.

Finally, on many occasions to complete the desired data structure, it is necessary to incur costs to purchase the data that are not available.