

14. Traffic safety pillars: safe vehicles

Introduction

Vehicle safety regulations and technologies play a critical role in reducing crashes. This module explores how regulations and technology intersect to create safer roads, with a focus on global frameworks and challenges in Africa. In this course we will discuss and learn about the importance of improving the level of vehicle road worthiness on new and used vehicles as well as how to improve periodic technical inspections of vehicles.

Learning outcomes

After completing this module, the students should be able to:

- List major life-saving technologies and key UN vehicle safety agreements.
- Map technologies to crash phases using Haddon's Matrix.
- Explain how type approval systems and harmonization improve safety.
- Compare regulatory approaches in different regions.
- Assess policy options for improving vehicle safety in Africa.
- Propose a strategy for integrating advanced safety technologies in low- and middle-income countries.

Key messages to learners

- A modern vehicle is equipped with various passive and active safety systems such as seatbelts and airbags, Anti-lock Braking Systems (ABS), Autonomous Emergency Braking (AEB), etc. They have been proven to significantly improve crash worthiness of vehicles and reduce injury and fatality risks. The vehicle safety technology is constantly evolving, thus modernization of the national vehicle fleet by scrapping older vehicles and replacing them with new(er) ones is an essential component for any national traffic safety strategy. Periodic Technical Inspection (PTI) is a key mechanism for ensuring that only vehicles meeting minimum safety and environmental standards remain in use.
- Majority of the vehicles being imported into the African countries are used vehicles from Europe, Japan, and the USA, though there is still a share of new vehicles imported. As these vehicles are imported from various countries, the safety standards can vary based on the laws in the exporting country.
- There is an urgent need to significantly improve the level of crash roadworthiness of imported vehicles to the African countries. If and where local assembly or production of vehicles happen in African countries, regulations play a vital role in controlling the quality of vehicles being produced.
- International regulatory frameworks, such as the UN Agreements (1958, 1997, 1998), establish harmonized standards for vehicle safety through type approval systems. These regulations ensure that vehicles meet minimum safety requirements before entering the market. South

Africa, Nigeria, Egypt, and Tunisia have already adopted the UN regulation, yet many African countries still lag.

- Many of vehicles currently in operation on African roads are sub-standard, with issues like faulty brakes, malfunctioning lights, or defective seatbelts being quite common. These defects significantly increase the likelihood and severity of road crashes. In Europe, PTI is a well-established part of a vehicle's lifecycle. Directive 2014/45/EU mandates that vehicles undergo their first inspection four years after registration, followed by biennial checks. However, member states may impose stricter requirements—for example, Sweden mandates inspections every 14 months, while France requires a PTI certificate less than six months old at the time of vehicle sale. Research supports the positive effect of PTI, for example Elvik (2023) found that a 20% increase in PTIs for heavy goods vehicles corresponded with a 4%–6% reduction in crashes.
- When buying a new vehicle, a customer often lacks access to the information (or cannot fully understand it due to overly technical language) about the safety features available in different models, thus choices are often made based on preferences of colour, interior design or stereo system sound. New Car Assessment Programs (NCAP) aim to make safety information accessible through a simple star-rating system so that the customers can weigh in safety in their decision making. In Western countries, NCAP has a prominent effect on the vehicle manufactures, urging them to introduce new safety features in order to get highest star rating. While vehicle standards and regulations require the most basic safety features (brakes, seat belts, lamps), the NCAP constantly pushes the frontiers by making newly invented safety features available in vehicles put on the market. The Global NCAP programme is particularly relevant for Africa since it aims at testing vehicles sold outside the traditional European and North American markets.
- There is also the need to develop clear and comprehensive vehicle scrappage policies in African countries that outlines the criteria for identifying end-of-life vehicles. Repairing of crashed vehicles in an incorrect way could potentially influence the crash worthiness. Therefore, scrapping of very old and not roadworthiness vehicles should be encouraged. If repaired, repair guidelines form the manufacturer needs to be followed.

Learning activities

Exercise 1

Imagine a traffic accident with a crash between a passenger car and a truck. Complete the Haddon's Matrix related to *vehicle safety technologies*.

	Pre-crash	During crash	Post-crash
Road user	...	...	...
Vehicle	...	...	...
Infrastructure	...	...	...
Regulations	...	...	...

Possible answer:

	Pre-crash	During crash	Post-crash
Road user	use of seat belts and child restraints	proper seating position, belt worn correctly so restraints work	activate emergency blinkers
Vehicle	ABS, ESC, FCW, AEB, LDW/LKA, driver monitoring, seat-belt reminders	seat belts, pretensioners, load limiters, airbags, head restraints, strong structure	e-Call / crash notification, hazard lights, fuel cut-off, door unlock, multi-collision brake
Infrastructure	clear signs and road markings (for lane keeping and sign recognition systems), setting safe speed limits management	barriers, crash cushions, forgiving roadside (it matters WHAT a vehicle collides with)	infrastructure to receive and react to e-Call, accident warning to other drivers/vehicles
Regulations	vehicle inspections (periodic and during import), vehicle safety standards, driver education on usage of seatbelts, schemes for renewal of vehicle fleet	safety standards to require minimal passive safety features, inspections to ensure basic functioning	emergency services, right for emergency help (who will receive and react to the e-Call?)

Exercise 2

For the same traffic safety problem, place the suggested measures on the accident timeline: Place different safety technology on accident timeline (at least two per column).



Normal driving	Deviation	Emergency	Collision unavoidable	Crash	Post-crash
Education about risks of fatigued driving	Lane departure warning	Forward collision warning	Crash-imminent braking / Autonomous braking systems	Passive safety features: Seatbelts	e-Call
Journey planning / rest-break planning	Fatigue/drowsiness alert	Autonomous emergency braking	Seat belt pretensioners	Driver and Passenger Airbags	Automatic crash notification
Driver drowsiness and attention warning system	Driver distraction warning	Emergency lane keep assist	Seat-belt load limiters	Side airbag	Post-collision braking
Seat-belt reminder	Blind-spot warning		Adaptive restraint preparation	Head restraints	
Adaptive cruise control				Crumple zones	

Exercise 3

Many African countries import a large number of vehicles, including used vehicles. Safety standards may differ between exporting countries. Using the UN vehicle safety framework, describe two ways governments can improve vehicle safety. Then give one example of how this could be applied in your country.

Guidelines for evaluation:

1. A strong answer should show that the student understands why this is a road safety issue:
 - Many African countries import a high share of used vehicles, and these vehicles may not meet modern safety standards.
 - Safety standards differ depending on the exporting country, so imported vehicles may come with very different levels of protection.
 - Safer vehicles are important because vehicle safety helps both to prevent crashes and to reduce injury severity when a crash occurs.
2. Reference to UN Framework
 - The UNECE / UN WP.29 framework develops international vehicle safety regulations.
 - The 1958 Agreement supports harmonized technical requirements and the mutual recognition of type approvals between contracting parties.
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 - The 1958 Agreement supports harmonized technical requirements and the mutual recognition of type approvals between contracting parties
3. Policy measure:
 - The strongest answers should focus on:
 - Set minimum import safety standards for used and new vehicles
 - Introduce inspection, homologation, or technical checks
4. Other answers may include:
 - Restrict unsafe or very old imports
 - Use taxes or incentives to promote safer vehicles
 - Strengthen enforcement and compliance systems
 - Consumer information / NCAP-type safety information

Exercise 4

New Car Assessment Programs (NCAP) challenge vehicle manufacturers to exceed regulatory minimums by rating vehicle safety performance. Discuss how the different countries in Africa can adopt NCAP ratings to increase customer awareness of vehicle safety.

Guidelines for evaluation

1. A strong answer should show that the student understands the purpose of NCAP:
 - NCAP is a consumer information program that independently tests and rates vehicles so buyers can compare safety performance more easily.
 - NCAP is meant not only to inform consumers, but also to push manufacturers beyond legal minimum standards by making safety performance visible in the market.

- In the African context, Global NCAP's #SaferCarsForAfrica program has already shown large differences in safety performance between vehicles sold on the continent
2. Further, a good answer should recognize why NCAP awareness matters in Africa:
 - Many African countries rely heavily on imported vehicles, especially used vehicles, and safety standards can vary a lot between source markets.
 - Some vehicles sold in African markets have been criticized for a 'double standard', where versions sold in Africa have fewer important safety features than vehicles sold elsewhere.
 - Public awareness is important because consumers often do not have easy access to independent safety information when buying a vehicle. NCAP ratings can help fill that gap.
 3. Possible ways for countries in Africa to work with NCAP:
 - Require NCAP star labels or safety information at the point of sale for both new and used cars. If a car is imported, then the safety rating of the country of origin should be available.
 - Use public information campaigns adapted to local markets
 - Official government or consumer websites with NCAP ratings
 - Use NCAP in public procurement and fleet purchasing
 - Link NCAP ratings with tax, finance, or insurance incentives
 - Work with regional organizations and consumer groups.

Assessment quiz

The assessment quiz can be used as a part of the examination, or as another form of learning activities.

Question 1

Which UN Agreement focuses on mutual recognition of type approvals?

- The 1998 Agreement (**incorrect**)
- The 1997 Agreement (**incorrect**)
- The 1958 Agreement (**correct**)
- The Vienna Convention on Road Traffic (**incorrect**)

Question 2

Explain how ABS prevents crashes.

- It increases engine power during overtaking. (**incorrect**)
- It prevents wheel lock-up during hard braking, helping the driver maintain steering control and traction. (**correct**)
- It automatically inflates airbags before a crash. (**incorrect**)
- It reduces fuel consumption at high speed. (**incorrect**)

Question 3

What is the role of NCAP in vehicle safety?

- to issue driving licenses and increasing overall safety (**incorrect**)
- to repair unsafe vehicles after a crash to make them roadworthy again (**incorrect**)
- to independently test vehicles, publish safety ratings, and help consumers compare safety performance (**correct**)
- to provide road construction standard. (**incorrect**)

Question 4

What challenges does Africa face in vehicle safety domain?

- a. Most imported vehicles are not new and do not meet modern safety standards such as ABS, ESC, airbags, or adequate crash protection. (correct)
- b. Cities start introducing speed humps at pedestrian crossings that over time can cause damage to passing cars. (incorrect)
- c. Buyers of new and used vehicles are not well aware of existing vehicle safety features and do not demand them from dealers/manufactures. (correct)
- d. It is difficult to find safe parking space for expensive vehicles that can be stolen. (incorrect)
- e. Vehicle inspection systems have limited capacity, meaning faulty vehicles remain undetected for long time. (correct)

Question 5

What policy measures could be used to improve safety in an country with 80% used, imported vehicles?

- a. Set minimum import safety standards for used vehicles (requirements for functioning seat belts in all seats, airbags, ABS/ESC, compliance with basic crashworthiness tests) before a vehicle can be imported or registered. (correct)
- b. Allow only vehicles of well-known brands to be important, since it is easier to find spare parts for them. (incorrect)
- c. Strengthen periodic technical inspection (PTI) so that imported vehicles are checked regularly for brakes, tires, lights, steering, emissions, and the functioning of safety systems such as seatbelts and airbags. (correct)
- d. Use taxes or incentives to favour safer vehicles, such as lower import duties for vehicles with better safety equipment and higher taxes on substandard vehicles. (correct)
- e. Introduce the minimal speed requirement in order to remove slow moving vehicles from the roads. (incorrect)
- f. Improve consumer information and awareness, so buyers understand the safety difference between low-spec and safer imported vehicles. Use NCAP ratings and public information can support better choices. (correct)

Recommended reading and resources for students

- Global NCAP. (n/d). *Global New Car Assessment Programme*. <https://www.globalncap.org>
- Mackay, M. (2021). Current vehicle safety technologies and future directions. In G. Tiwari & D. Mohan (Eds.), *Transport and safety: systems, approaches, and implementation*. Springer Nature. https://doi.org/10.1007/978-981-16-1115-5_10
- Page, Y. (2021). Possible futures of vehicle safety. In G. Tiwari & D. Mohan (Eds.), *Transport and safety: systems, approaches, and implementation*. Springer Nature. https://doi.org/10.1007/978-981-16-1115-5_11
- Zafar, F., Beer, K., Tan, T., Mani, A., & Beer, T. (2021). *Guide to Road Safety Part 5: Safe Vehicles* (AGRS05-21). Austroads. <https://austroads.com.au/publications/road-safety/agrs04>

Recommended (additional) reading for teacher

- GRSP, & World Bank. (2021). *Guide for road safety interventions: evidence of what works and what does not work*. Global Road Safety Facility | The World Bank. <https://openknowledge.worldbank.org/entities/publication/16d7b276-09b1-58f8-94d6-112064b8af5f>
- Lie, A., & Tingvall, C. (2002). How do Euro NCAP results correlate with real-life injury risks? A paired comparison study of car-to-car crashes. *Traffic Injury Prevention*, 3(4), 288–293. <https://doi.org/10.1080/15389580214632>
- Seiffert, U. W., & Wech, L. (2007). *Automotive safety handbook*. SAE International. <https://doi.org/10.4271/R-377>.
- UNECE. (2022). *Safer and cleaner used vehicles for Africa*. United Nations Economic Commission for Europe. <https://unece.org/info/publications/pub/378464>
- UNECE. (2022). *World forum for harmonization of vehicle regulations: how it works – how to join it* (ECE/TRANS/289/Rev.1). United Nations Economic Commission for Europe. https://unece.org/sites/default/files/2022-07/ECE_TRANS_289_Rev.1_E_corrected.pdf
- WHO, & UN. (2021). *Global plan: decade of action for road safety 2021–2030*. World Health Organisation & United Nations. <https://cdn.who.int/media/docs/default-source/documents/health-topics/road-traffic-injuries/global-plan-for-road-safety.pdf>
- WHO. (2023). *Global status report on road safety*. World Health Organization. <https://iris.who.int/bitstream/handle/10665/375016/9789240086517-eng.pdf>

Prepared by expert

In case you have specific questions, need a discussion partner, or just want feedback on your lecture materials, you may reach out the author(s) of this module. Please, put ‘AfroSAFE curriculum’ in the email subject.



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