

great promise in removing many of the risks of using a car and saving many lives.

In ten years we will look back and realise that the ‘cars for tomorrow’ have done their job.

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# ASEAN NCAP: Today and its future undertakings

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## Abstract

The New Car Assessment Program for Southeast Asian Countries, or ASEAN NCAP, is the newest addition to the established NCAP initiatives around the world. ASEAN NCAP is targeted to improve the safety aspects of private cars in the region, which come second in terms of volumes and the number of fatalities based on vehicle categorisation after the two-wheelers. As NCAP is originally focusing on crashworthiness evaluation via crash tests, more NCAP organisations have already put more focus on active safety by encouraging the fitment of Safety Assist Technologies (SATs) in new cars. ASEAN NCAP views SATs as a critical necessity in ASEAN countries since they not only bring a

crash avoidance element for cars but also can improve the situation on the road to address motorcycle issues.

## Keywords

ASEAN NCAP, Safety Assist Technologies, Vehicle safety

## Introduction

The journey to establish a New Car Assessment Program, in Malaysia began in 2007 when the Malaysian Institute of Road Safety Research (MIROS) was founded. The founder and inaugural MIROS Director-General, the late Professor Radin Umar Radin Sohadi, was the one who outlined the importance of NCAP in Malaysia as well as for the neighbouring countries. His strategic framework to introduce road safety interventions (Table 1) was developed based on the Haddon Matrix, in which most of them were included in the previous Malaysia's Road Safety Plan 2006 – 2010 [1].

In a brief overview about Malaysia's automotive history, particularly after the country had achieved its

independence, it can be divided into two main eras – the 1960's local assembly initiative and the national car project in the 1980's [2]. The former was mainly to encourage local assembly industries that had been inspired by the Colombo Plan experts, while the latter was to upgrade the country's car industry to another level by producing homegrown cars based on the National Car Policy idea mooted by Malaysia's former Prime Ministers, Tun Dr. Mahathir Mohamed. This advancement matched the "automotive development stages" predicted by the experts for developing countries such as Malaysia, in which the development starts with just importing CBU's to assembly of CKD's, then to embed local content in CKD's and finally to have a full scale manufacturing capability [3]. The only Malaysian born company that is able to reach that stage is Proton, while others are still in the second or third stage.

With regard to automobile safety development in Malaysia, there is nothing much to be said until Malaysia introduced UN Regulations in its Vehicle Type Approval (VTA) and the intention by MIROS to have the NCAP in the country. The local car manufacturers were having a rather slim chance to be assessed in any established NCAP due to its sales volume and market domination (import), while non-local manufacturers were still "selling" their foreign NCAP achievement for local commercials. This was the painful

moment for the safety promoters, e.g. the Road Transport Department (RTD), Road Safety Department (RSD) and MIROS, since some of those claims can be considered as half-truth. This has misled the consumers to blind "brand trust" without carefully looking at what is offered for local market from the specification sheet, let alone the reliable crash test to testify those claims. It is more often than not, that consumers come across the famous footnote guided by the asterisk – "*the specifications might be different from the car shown above*" – with the font size of probably four or below? Obviously, this is becoming a "normal practice" without anyone really caring to protect the consumers' right to the real understanding of car safety than just admiring the enlarged five-stars plate in the middle of the ads.

Therefore, the new era of automobile safety has presumably come at the right time in this new millennium years after the two abovementioned milestones that without a doubt had changed the country's automotive layout significantly. Furthermore, the ultimate benchmark is at the country's two largest automobile producers – Proton and Perodua. Those involved in the early days when NCAP in Malaysia was still on paper agreed that "vehicle safety" is the way forward for the auto industry in Malaysia. Proton has positively progressed in that aspect, from a donor car by Mitsubishi at the beginning to a model that had achieved three-stars

**Table 1: Road safety strategic interventions**

	<b>Pre-Crash</b>	<b>Crash</b>	<b>Post-Crash</b>
<b>Road User</b>	<ul style="list-style-type: none"> <li>➤ Road safety education</li> <li>➤ Driver training program and grading of driving institutes</li> <li>➤ Automated Enforcement Systems (AES)</li> <li>➤ Publicity campaigns</li> <li>➤ Community-Based Program (CBP)</li> <li>➤ Road user assessment program (RUAP)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Compliance and correct use of Active Safety features</li> </ul>	<ul style="list-style-type: none"> <li>➤ Skills of paramedics and first respondents</li> </ul>
<b>Vehicle</b>	<ul style="list-style-type: none"> <li>➤ Vehicle Type Approval (VTA)</li> <li>➤ <b>NCAP Ratings</b></li> <li>➤ Rear seatbelt</li> <li>➤ Under-run for HGV</li> <li>➤ Vehicle inspection</li> </ul>	<ul style="list-style-type: none"> <li>➤ Passive safety system</li> <li>➤ Crash compatibility</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ease of evacuation tools</li> </ul>
<b>Road and Environment</b>	<ul style="list-style-type: none"> <li>➤ Road safety audit</li> <li>➤ Black spot treatment</li> <li>➤ Motorcycle lanes</li> <li>➤ iRAP</li> </ul>	<ul style="list-style-type: none"> <li>➤ Clear zones</li> <li>➤ Barrier systems</li> <li>➤ Crash cushions</li> </ul>	<ul style="list-style-type: none"> <li>➤ Easy access by first respondents</li> <li>➤ Trauma centre</li> </ul>

in Euro-NCAP's adult occupant safety (Proton Waja; or Impian in the United Kingdom's market), and finally the Proton Prevé that has bagged five-star status in an overall assessment by the Australasian NCAP (ANCAP) in 2013 [4]. Perodua, on the other hand, still has much influence from its Japanese counterpart – Daihatsu – so it was not a “worrisome situation” to the group of “NCAP believers” that Perodua will be left behind since the “economic competitiveness” in the domestic “automotive ecosystem” was still the main concern.

## The Development of ASEAN NCAP

The Malaysian Vehicle Assessment Program (MyVAP) came into the picture in 2009, which had expectedly received mixed reactions especially by the manufacturers. The inception of MyVAP was intended to fill the gap in the industry prior to what is called the “Malaysian NCAP” or “MyNCAP” initiative. MyVAP is an exercise similar to NCAP (primarily in giving star ratings to car models) but only using “secondary data” voluntarily provided by the participating manufacturer. Even though the exercise is mostly paper-based, the knowledge that grows from this activity was incredible to the “NCAP team” at MIROS [4].

In about three years of MyVAP era, only local manufacturers Proton and Perodua had participated with both bringing forward their best two models. It started with Proton Exora (four-star), Perodua Alza (four-star), Perodua Myvi (four-star) and finally by the only five-star MyVAP car, Proton Prevé [4]. Meanwhile, the non-local manufacturers had been closely monitoring the progress of MyVAP, though their hesitation to be involved in the exercise was quite apparent. Nevertheless, there was a notable scenario of increased safety items for new cars in the market and since then many models were launched with the likes of airbags and anti-lock braking system (ABS) as standard fit. In 2012, MIROS – though without any specific recognition – had concluded that MyVAP was a successful “soft-landing program” for three reasons: (1) local manufacturers had the readiness and ample time to cope with the more stringent scheme in NCAP; (2) the message was conveyed to the internationally established manufacturers who are apparently able to meet NCAP requirements in the developed market; and (3) MIROS had ample time for its capacity building in both know-how and preparing the necessary facilities (crash lab).

The World NCAP, an initiative led by the Australasian NCAP (ANCAP), had changed the game plan in which the first manufacturer meeting with the Japanese manufacturers was held in Tokyo in October 2010. This was an important move since the Japanese manufacturers dominated the Southeast Asian market including Malaysia. Furthermore, the most important point in the journey of ASEAN NCAP then came after the newly-established Global NCAP – an organisation supported by the FIA Foundation to materialise

the Safer Vehicle Pillar in the United Nations' Decade of Action – led the way to ASEAN NCAP establishment in November 2011. A Memorandum of Understanding was signed in Delhi, India between MIROS and Global NCAP to establish a regional-based NCAP called ASEAN NCAP, in which for MIROS it became a bigger initiative than the original idea of MyNCAP [1].

Furthermore, MIROS during the same period had started to build their very own crash laboratory after three years of research and development works. This self-designed crash lab project called MIROS PC3 held its first crash test on 24th May 2012 during the Automotive Safety Week Southeast Asia (2012) event in Melaka, Malaysia, in conjunction with the inaugural Global NCAP Annual Meeting [5]. Since then, the regional NCAP program has grown extensively with strong support by other established NCAPs as well as the world's prominent crash testing equipment suppliers. Among others, the Australasian NCAP (ANCAP) had contributed significantly to ASEAN NCAP establishment in the form of organisational and technical support [6].

To date, ASEAN NCAP has completed two phases of evaluation with 19 passenger cars' variants and is expected to complete the third and final phase of the so called “pilot stage” by the end of the first quarter in 2014. The earlier two phases have incorporated frontal offset deformable barrier (ODB) tests at the closing speed of 64 km/h (Figure 1). From this single crash test, the evaluation is done in two forms – the Adult Occupant Protection (AOP) based on the injury performance from the adult dummies on the front seats (Hybrid III 50th-ile; driver and front passenger), and the assessment of Child Occupant Protection (COP) based on the child dummies' injury assessment and physical examination of the “child seat-friendly” characteristics. The former is marked by star rating where five-star is the best, while the latter is rated by percentage where 100 percent is the best. Table 2 describes the results from ASEAN NCAP's first two phases.

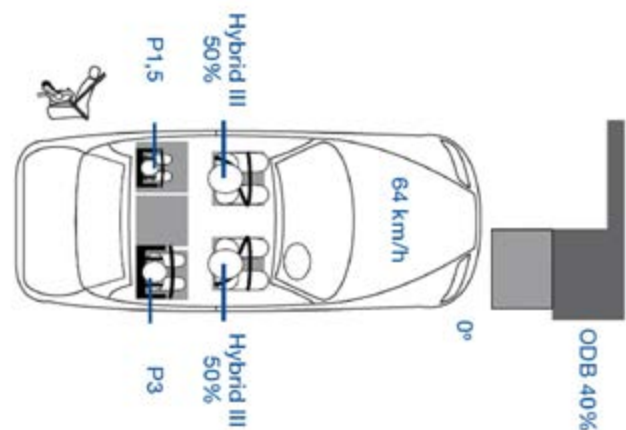


Figure 1. ASEAN NCAP frontal offset test configuration (64 km/h)

Moreover, in the first two phases, a pre-requisite was also introduced in AOP rating whereby only cars that are equipped with seat-belt reminder (SBR) for both driver and front passenger and the Electronic Stability Control (ESC; or similar technology) are eligible for five-star. This means the failure to meet both requirements by a five-star car from the crash test will be penalised to four-star [1]. ASEAN NCAP is committed to bring the ASEAN NCAP assessment to the level of other established NCAPs; therefore, new requirements in the assessment scheme have been deliberated with the manufacturers (ASEAN NCAP OEM Meeting Series) in a dynamic but progressive road map. From Phase Three onwards, ASEAN NCAP has introduced another pre-requisite based on the UN Regulation No. 95 (R95; lateral impact). This pass-fail R95 conformation test will be another pre-requisite to determine the eligibility to be awarded four-star and above. It has now become a common understanding that this current ASEAN NCAP's assessment scheme will remain until December 2016,

since after that ASEAN NCAP is expected to introduce a “combined rating” from multiple assessments/crash tests.

## Future challenges to ASEAN NCAP

The main concern in road safety for the ASEAN region goes to the motorcycle issues that push the intriguing mind to the question of “how relevant is NCAP for ASEAN now?” Nevertheless, the ASEAN NCAP movement is important for two obvious reasons: (1) NCAP and crash test for passenger cars are established programs in which the assessment is more “objective” and widely accepted to improve the situation; and (2) the same initiative for motorcycles has a “long way to go” since the vulnerability of motorcyclist on the road is a totally different issue as compared to car occupants. Therefore, the medium-term plan in ASEAN NCAP should also look into giving the benefits to motorcycle users through NCAP. With so many new technologies introduced for passenger cars, NCAP should further promote these “active safety” elements in

**Table 2: ASEAN NCAP results from Phase I and II**

Make and Model	Origin	Airbag	AOP : Star <sup>b</sup>	COP	Note
<b>PHASE I</b>					
Ford Fiesta	Thailand	7	15.73 : <b>5</b>	66%	Not affected by SAT
Honda City	Malaysia	2	15.44 : <b>(4) &amp; 5</b>	81%	4-star for tested variant (ESC)
Toyota Vios	Malaysia	2	13.61 : <b>4</b>	48%	Not affected by SAT
Nissan March	Thailand	1	11.66 : <b>4</b>	48%	Not affected by SAT
Proton Saga FLX+	Malaysia	2	10.23 : <b>3</b>	58%	Not affected by SAT
Perodua Myvi	Malaysia	2	8.71 : <b>3</b>	54%	Not affected by SAT
Hyundai i10	Malaysia	2	7.31 : <b>2</b>	48%	Not affected by SAT
Proton Saga <sup>a</sup>	Malaysia	1	4.30 : <b>1</b>	49%	Not affected by SAT
<b>PHASE II</b>					
Toyota Prius	Japan	7	15.30 : <b>5</b>	86%	Not affected by SAT
Honda Civic	Thailand	2	14.63 : <b>(4) &amp; 5</b>	82%	4-star for tested variant (ESC)
Subaru XV	Japan	3	14.31 : <b>5</b>	67%	Not affected by SAT
Suzuki Swift	Malaysia	2	13.32 : <b>4</b>	77%	Not affected by SAT
Mazda 2	Thailand	2	13.10 : <b>4</b>	78%	Not affected by SAT
Mitsubishi Mirage	Thailand	2	13.07 : <b>4</b>	43%	Not affected by SAT
Toyota Avanza	Indonesia	2	12.98 : <b>4</b>	38%	Not affected by SAT
Perodua Alza	Malaysia	2	12.86 : <b>4</b>	46%	Not affected by SAT
Nissan Almera	Thailand	1	12.74 : <b>4</b>	52%	Not affected by SAT
Daihatsu Xenia	Indonesia	2	12.34 : <b>4</b>	33%	Not affected by SAT
Mitsubishi Pajero Sport	Thailand	2	12.08 : <b>4</b>	40%	Not affected by SAT

<sup>a</sup> Proton Saga (Phase I) was taken out from market since the second quarter of 2013.

<sup>b</sup> Parentheses – ( ) – refer to the tested variant. ASEAN NCAP did recognise the variant that offered ESC as standard fit (five-star) as happened in both Honda City and Honda Civic case.

new cars. These safety technologies, also known as Safety Assist Technologies (SATs), will not only benefit the car users especially in minimising the risk of getting involved in road crashes but also “protecting” motorcyclists from similar risks.

The latest technology that has been considered in our road maps is the Blind Spot Detection and Automatic Emergency Braking (AEB). These two technologies are perhaps the best bet to complement ESC and SBR that are already in the rating structure. More technologies, categorised as the Advanced Driver Assistance System (ADAS), are now becoming a trend in modern cars. They are meant to reduce accident probability and indirectly to reduce possible injuries from road crashes. Furthermore, it is hoped that these technologies could reduce the alarming number of motorcyclists’ fatalities in the region, which sums up to 50% from all road user’s categories. For example, in Malaysia alone, the number of fatalities among motorcycle users is more often than not exceeding 50 percent of the annual total death toll [7].

Nevertheless, the rationale to promote more SATs will very much depend on available infrastructure and environment. For example, Lane Departure Warning (LDW) will become a witticism if the lane itself does not exist (multiple lanes carriageway) in certain countries or regions in a country. Another challenge is that ASEAN NCAP, due to its limitation of test facility and assessment capability, will not be able to evaluate the SATs functionality and effectiveness objectively. Still, ASEAN NCAP will keep promoting SATs, in which the “quick win” strategy is through the “pre-requisite” requirement in the rating scheme.

On the other hand, the ASEAN community in general is obviously far away from what is called “autonomous driving”. The recent development of such safety technology is eminent in developed countries such as Japan, Europe and the United States. A Japanese manufacturer, Nissan, has already announced that the system would be available by 2020 [8]. Optimistically this can be done if the infrastructure, environment and technology can fit into the required level in Intelligent Transportation System (ITS). For example, Japan is looking seriously into this via their comprehensive ITS framework and their high-end infrastructures. At ASEAN NCAP level, manufacturers are encouraged to develop what is “friendly” to the ASEAN transportation system. There is a possible recognition from ASEAN NCAP in its future Grand Prix award to any effort to improve active safety via SATs and ITS.

It is believed that ASEAN NCAP will reach its maturity in passive safety assessment by 2017. Passive safety that generally involved various crash test configurations – pedestrian protection, pole impact, etc. – is a rather straightforward effort since the first and greatest hurdle had already been overcome by MIROS through the establishment of the MIROS PC3 crash laboratory. The remaining challenges are to include the abovementioned tests into the rating scheme (2017 onwards). This basically

means MIROS and ASEAN NCAP have to ensure enough financial sources to implement more tests.

## Conclusion

In today’s modern society, safer mobility has become a critical concern in both developed and developing countries. However, the need for a great improvement in the transportation system is explained by the fact that 90 percent of road fatalities occurred in low and middle-income countries. This indicates that, mobility is not only about accessibility but also it must address sustainability in terms of affordability and most importantly the access to safety. Therefore, ASEAN NCAP has to work together with the vehicle manufacturers and also to educate the users or specifically car owners, in order to achieve the ultimate outcome from the NCAP initiative.

Michelangelo once said, “*The greater danger for most of us is not that our aims are too high, and we miss it, but that it is too low, and we reach it.*” ASEAN NCAP’s challenge in the next five years is not only about producing safer cars but most importantly to establish the “safety brain” in each ASEAN country as the agent of car safety. By participating in automotive conferences all over the ASEAN region and launching the results in various ASEAN cities, it is expected that the information of ASEAN NCAP will be further distributed and well-understood. Therefore, the more consumers purchase safer cars based on ASEAN NCAP results, the more positive outcome will prevail on ASEAN roads.

## Acknowledgements

The authors would like to express their heartfelt gratitude to all members of MIROS who had been directly or indirectly involved in the development of ASEAN NCAP. Also, we take this opportunity to convey our sincere thanks to Global NCAP and FIA Foundation for the birth of ASEAN NCAP through both technical and financial support. Our special mention also goes to the rest of NCAP families – Australasian NCAP, Latin NCAP, Japan NCAP, Euro-NCAP, US NCAP, IIHS, Korea NCAP and China NCAP – for their continuous support and guidance.

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## Navigating toward zero fatalities: the role of NCAPs

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In the nearly 20 years since the Insurance Institute for Highway Safety (IIHS) began publishing crashworthiness ratings for consumer information, great progress has been made in reducing the toll from motor vehicle crashes in the United States. The drop in deaths and injuries during that time continued a trend that began in the 1970's. Along with important changes in people's behaviour spurred by cultural and legislative shifts - notably a reduction in alcohol-impaired driving and wider use of seat belts - the improved safety of vehicles has been a key factor in this drop.

When we look at the crash statistics and compare the vehicles being sold today with those of just a few decades ago, the United States appears to be sailing inevitably toward the goal of zero fatalities. The crash death rate per capita has fallen by almost half since 1975 and the fatality rate per billion miles travelled went from 34 in 1975 to 11 in 2012 [1]. Frontal and side airbags, as well as electronic stability control, are now virtually universal in new passenger vehicles and systems capable of stopping some crashes altogether are rapidly spreading. Autonomous driving is coming in the not-too-distant future, with the technological groundwork already laid.

But the destination of near-zero fatalities is a lot farther than it appears when looking out from the bow of the highway safety ship. It will take a lot of work to move the ship in the right direction over the long journey.

### Steering the ship with safer vehicles

The research community is good at figuring out which vehicle features can reduce fatalities and injuries, and New Car Assessment Programs (NCAPs), including the IIHS vehicle ratings program, have encouraged manufacturers to adopt these features. Government regulation has, in some cases, sped things along even further.

But even when a feature is mandatory in new vehicles, it still takes decades before all vehicles on the road are equipped with it. A study by our affiliate, the Highway Loss Data Institute, found that it takes about three decades or longer from the time a promising safety feature is introduced until it is on 95 percent of registered vehicles [2].

The reason is simple: Just because a feature is available does not mean the entire driving population will immediately go out and replace their vehicles. Given the current conditions of approximately 240 million registered passenger vehicles and about 10 million new vehicles registered a year, it would take about 24 years for the fleet to completely turn over (not counting classic cars and vehicles that people hold on to for sentimental reasons). In reality, it takes longer because not every new vehicle replaces one of the oldest.

Take, for example, electronic stability control. ESC was first introduced in the United States in the 1995 model year and quickly proved its worth. The most recent IIHS study found it reduces fatal crash involvement risk by 33 percent - 20 percent for multiple-vehicle crashes and 49

percent for single-vehicle crashes [3]. Previous studies had shown similarly large benefits, prompting us to make the technology a requirement for our award, *TOP SAFETY PICK*, beginning in 2007. The U.S. government began phasing in a requirement for ESC with the 2009 model year; all new passenger vehicles have had it since the 2012 model year.

Despite all these efforts to encourage the quick adoption of ESC, the technology is predicted to be available on 95 percent of the vehicle fleet only in 2029 (Figure 1).

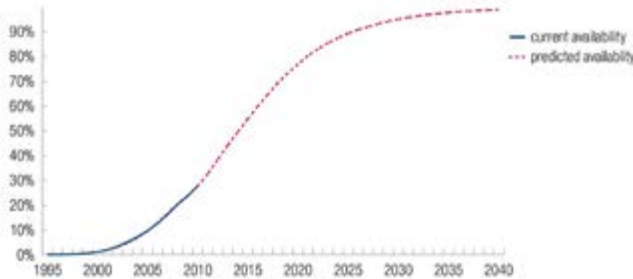


Figure 1. Predicted percentage of registered vehicles with ESC

It is important to note that availability means just that: HLDI counted vehicles for which a given technology was either standard or optional, meaning the actual presence of ESC in the vehicle fleet will be less than 95 percent in 2030.

In short, our ship turns slowly, and that makes steering correctly that much more important. Safety advocates need to agree on the course we are taking. Are we committed to maintaining and improving crashworthiness? What role will crash avoidance play and what shape will that take in the future? Autonomous vehicles? Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication? Some combination of the two? In addition to maintaining a steady course, it is imperative that NCAPs work in close cooperation with regulators to keep them abreast of our trajectory and vice versa. For example, IIHS and other ratings organisations currently are encouraging the adoption of self-contained crash avoidance systems, while governments have been putting research dollars into V2V and V2I. These technologies are not necessarily at odds with each other but must be coordinated.

## Staying the course

IIHS has been successful in large part because we move methodically and deliberately. We have been supporting and conducting highway safety research for more than half a century; long before we began our ratings program. Throughout this history, whenever research has confirmed the value of a given countermeasure, we have pushed for it and kept pushing.

Our work on truck underride is just one example. IIHS first demonstrated the inadequacy of the U.S. standard for

rear underride guards - the metal bars on the backs of large trucks meant to keep a passenger vehicle from traveling underneath in a crash - in the mid-1970's [4]. We crashed 1976 Ford Granadas and 1976 Chevrolet Chevettes into the backs of parked semitrailers, first with the trailer manufacturer's underride guard and then with one of two prototype guards developed by IIHS. In each of the crashes using the manufacturer's guard, the resulting intrusion into the occupant compartment was devastating, and in a real crash the driver would have been killed. When the same tests were conducted with our prototypes, there was no underride.

Despite our tests, the pace of government regulation in this area remained disappointingly slow. Finally, in January 1998, an updated rear underride guard standard took effect. This new standard improved the strength of the guards but still was not tough enough. In 2010, IIHS studied how guards built to comply with the federal standards were performing in real-world crashes and found that many failed, allowing severe passenger vehicle underride and resulting in serious or fatal injury [5]. IIHS petitioned the government to improve the standard and conducted more tests in hopes of having a direct influence on trailer manufacturers [6]. After the underride guard on a Hyundai Translead trailer failed to hold up in our test, the company came back with a redesigned guard that performed much better.

Our latest series of car-into-truck crash tests in 2013 showed that current-generation underride guards exceed the U.S. requirements and work well when passenger vehicles strike the centre of the trailer's rear. However, the tests showed that trailers from seven of the eight largest manufacturers do a poor job of preventing underride in crashes involving only a small portion of the truck's rear. Rear underride continues to be an issue, which means you can expect more work from us in this area.

Our vehicle ratings program is not quite as old as our underride work, but here too we keep a firm hand on the tiller. IIHS currently maintains ratings for close to 200 models. We first began putting vehicles through the moderate overlap frontal crash test in 1995. Automakers quickly incorporated protection in such crashes into their new designs. We added a side impact test in 2003, a dynamic evaluation of head restraints and seats for rear crash protection in 2004, and a roof-strength test in 2009. Each time, manufacturers responded quickly, and the majority of models sold in the U.S. today earn good ratings in all four of these tests.

We continue to raise the bar with our vehicle ratings. To achieve our highest award for 2014, *TOP SAFETY PICK+*, a vehicle must earn good ratings in the moderate overlap front, side, roof strength, and head restraint tests, as well as a good or acceptable rating in the small overlap front

test that we introduced in 2012 and a basic or higher rating for front crash prevention. Next year, the criteria will be tightened again.

Staying the course does not mean we do not ever adjust our navigation, however. Research plays a key role in alerting us to obstacles and guiding us toward favourable currents.

At the moment, there is a critical need for more research into advanced crash avoidance technologies, so that we can learn which features are effective. Results in the real world do not always conform to expectations based on track tests or in pilot studies because it is difficult to predict how drivers will react to a safety feature after it becomes widespread.

Two examples from a few decades ago demonstrate how features that show promise initially can fail to live up to expectations. Antilock braking systems perform well on the test track, but studies have found reductions in real-world crashes ranging from none to small and no effect on fatal crashes [7]. Real-world results of centre high mounted stop lamps (CHMSLs) were similarly disappointing. Required on all new passenger vehicles in the United States since the 1986 model year, these supplemental brake lights were predicted to cut relevant rear-impact crashes by half in urban areas. However, a study of insurance claims found CHMSL-equipped vehicles had only five percent fewer rear-end collisions than would have been expected without the additional brake lights [8].

While data are still scarce on many of the newest crash avoidance features, HLDI has been able to provide an early look at their effects through the claims data it collects from U.S. insurers. These studies show that front crash prevention systems, including forward collision warning and autobrake systems, are reducing crashes, as are adaptive headlights [9]. The effects of other systems are less clear. Initial HLDI analyses suggest that at least one feature, lane departure warning, may not live up to expectations. More research is needed to explain why that might be the case and whether the systems can be improved.

## Tides, winds and current

It is the goal of NCAPs, in partnership with other highway safety advocates, to chart the course and help maintain it through our influence on consumers, governments and automakers. As we do so, we need to take into account the tides, prevailing winds and underlying current. In the United States, government and public appetites for regulation tend to go up and down, depending on which party is in office and the politics of the moment. Economic and geopolitical crises can create temporarily unfavourable winds.

The HLDI study on the spread of safety technologies provides an example of how such factors can slow progress. Frontal airbags fit into the approximately 30-year timeline for 95 percent fleet penetration if the process is considered

to begin in the 1984 model year. In fact, the first airbags were available on cars sold in the United States in the early 1970's, but the domestic auto industry subsequently declared airbags unfeasible and lobbied against them. This was at a time when the industry and the nation were grappling with an oil crisis and an economy so bad it inspired the creation of a new metric called the "misery index," a combination of the unemployment rate and inflation rate. In 1980, Ronald Reagan was elected president on a pledge to rein in what he saw as excessive government regulation. These trends slowed the progress of airbags considerably, and it was not until after the U.S. Supreme Court ruled in favour of insurers' efforts to get airbags into passenger vehicles that this life-saving innovation took off in the U.S.

In today's world, a constant factor that safety advocates must consider is the underlying current of climate change and the pressure to reduce carbon emissions. To stay on course in this environment, NCAPs have to resist calls to accept the safety tradeoffs of lighter vehicles and instead encourage the growth of more efficient hybrid and electric technologies.

Although we all have the same zero-fatality destination in mind, NCAPs around the world are travelling on separate ships and coming from different ports. As a result, the tides and winds will affect us differently and the voyage will be longer for some than for others. In emerging markets, for example, the desire for cars that are affordable to a wide swathe of the population has resulted in a lack of consumer and government pressure for basic safety features. About a third of new vehicles sold worldwide fall short of the basic frontal crash protection provided by models sold in the United States, Europe, or Australia [10]. So, while the latest segment of our safety journey is being powered in part by sophisticated crash avoidance features, safety advocates in markets such as Argentina, Brazil, Indonesia, Malaysia and Mexico have different needs in the short term. Conversely, some smaller European markets such as Sweden are ahead of the United States. Their smaller vehicle fleet means they have a more nimble ship and their safety-conscious culture puts wind in their sails. These leaders will help chart the course for the rest to follow, identifying obstacles and barriers to be avoided.

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## The European New Car Assessment Programme

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### Introduction

The European New Car Assessment Programme (Euro NCAP) provides consumers with a realistic and independent assessment of the safety performance of some of the most popular cars sold in Europe. The organisation has an important influence on vehicle designs, leading to fewer traffic deaths on European roads.

Established in 1997, Euro NCAP is a non-profit international association independent of the automotive industry. It is backed by seven European governments (France, Germany, Sweden, the Netherlands, the United Kingdom, Luxembourg, and the Catalonia region of Spain); consumer groups through International Consumer Research and Testing organisation; European motoring clubs through the Fédération Internationale de l'Automobile (FIA Region 1, ADAC and ACI); and UK insurers through the Motor Insurance Repair Research Centre (Thatcham).

Euro NCAP's headquarters are in Brussels, Belgium, close to the European Commission and Parliament. Testing of vehicles is carried out at seven accredited laboratories

located in six Member States of the European Union: ADAC, BAST, CSI, IDIADA, Thatcham (with MIRA) and TASS.

Over the last 17 years, Euro NCAP has tested more than 500 vehicles, including superminis, small and large family cars, executive cars, MPVs, SUVs, pick-ups, roadsters and vans.

### Current and future crash tests

Vehicle buyers owe it to themselves and their families to choose the safest vehicle. To do so they need reliable, accurate and unbiased comparative information regarding the safety performance of individual models. In Europe, all new models must, by law, pass safety tests before they are sold, but these are minimum standards and the buying public is not informed about how well cars pass these tests. Euro NCAP encourages manufacturers to exceed the minimum requirements and ensures that car buyers can make an informed decision by issuing an easy-to-understand star rating for most popular cars.

Since 2009<sup>1</sup>, Euro NCAP has released an overall safety rating with a maximum of five stars for each vehicle. The rating is comprised of scores in four important areas:

- Adult protection (driver and passenger);
- Child protection;
- Pedestrian protection, and
- Safety assist technologies.

The underlying tests include full-scale frontal offset and side-impact barrier and pole tests, front-end component tests for pedestrian protection and seat sled tests for whiplash prevention in rear-end crashes. Seat belt reminders, speed limiters and electronic stability control also contribute towards a vehicle's rating. The overall score is calculated by weighing the four scores with respect to each other, while making sure that no single area is underachieving.

The overall rating scheme was introduced to provide a more balanced assessment of various vehicle safety aspects and to add more flexibility to the ratings scheme. In recent years, Euro NCAP has worked on a programme of stepwise updates to the rating scheme, focussing on the upgrade of existing crash tests and on adding tests of emerging crash avoidance and advanced driver assistance technologies:

### Adult occupant protection

In 2014, the assessment of whiplash neck injury has been extended to the rear seating positions. In 2015, an updated set of crash tests for front and side protection will be implemented, including a new full-width frontal crash test and updated barrier and pole tests. What Euro NCAP hopes to achieve is, amongst other things, better restraint systems for the rear passengers. For the full width frontal test this will be realised by assessing the risk of injury of a small female occupant, controlling forward head excursion and chest displacement and penalising the tendency to submarine (where the pelvis slides under the lap belt, resulting in abdominal injuries). The updated side barrier test will use a mobile barrier that is heavier, stiffer and wider than that used today and a more advanced side impact dummy in the driver seat. In addition, the new oblique pole test, aligned with the GTR procedure, will apply a geometric assessment of the head protection device. This will assess the area covered by side thorax/head or curtain airbags in both front and rear positions for different sizes of occupants as shown in Figure 1.



Figure 1. In 2015, the Euro NCAP side impact crash tests will be updated with new elements such as the Advanced European Mobile Deformable Barrier (AE-MDB) and the WorldSID mid-sized male dummy.

### Child occupant protection

In 2013, Euro NCAP introduced a child seat installation check and changed from P to Q dummies for the dynamic assessment. The installation check promotes better compatibility between vehicles and the most popular types of child restraints on the European market, an area which is often a cause of problems in the real world. Further updates are scheduled in the coming years, most importantly a change to taller child dummies - 6 and 10 year old - for the dynamic tests to cover the transitional size group between those children in integral child seats and adults. Finally, Euro NCAP will provide incentives for vehicle makers to design their vehicles to be compatible with seats approved according to the new UN R129 "i-Size" standard.

### Pedestrian protection

Step-wise updates to the subsystem (adult and child headform, lower leg and upper legform) tests have been introduced since 2010. Firstly, the headform impactors were harmonised with those specified in the GTR and European Regulation. Longstanding industry criticism about subjective impact location selection was addressed by implementing a grid approach first for bonnet and subsequently for bumper and bonnet leading edge testing. At the same time, the scope of the protocol was extended by incorporating the verification of deployable protection devices, such as pop-up bonnets. Finally, the lower leg test device was updated to the Flex PLI impactor with new criteria and limits in 2014 (Figure 2).

In 2015, the last of the test procedures, the upper leg test, will be updated to improve the correlation between real world injuries and assessment scores. The impact height will be standardised to match the estimated impact location of the adult male hip and new criteria and limits have been agreed.

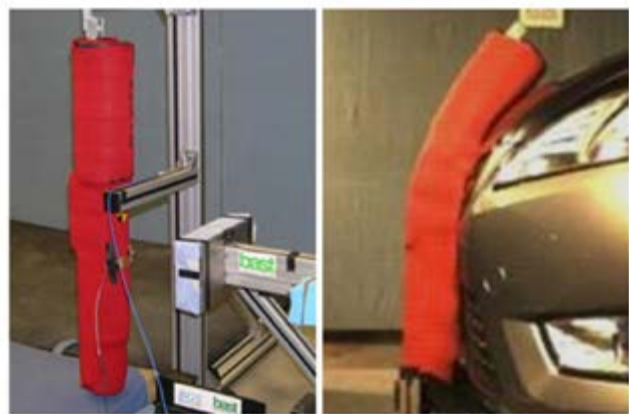


Figure 2. The Flex-PLI is used from 2014 to assess pedestrian knee and tibia injury risk.

## Advanced safety technology

The assessment area of Safety Assist was introduced to the rating to reflect the increasing importance of rapidly emerging crash avoidance technology. While only a few safety assist technologies were included initially (Seat belt reminders, Speed Limitation Devices and Electronic Stability Control), it is clear that considerable safety benefits can be realised by rewarding wider fitment of robust crash avoidance and driver assistant systems.

### Safety assist

Following the implementation of the ESC test in the rating scheme in 2011, the assessment of Speed Limitation devices was broadened in 2013 to include intelligent Speed Assistance Systems which employ digital mapping and/or speed sign recognition. In 2014, lane support systems were added to the assessment, as well as autonomous emergency braking systems (which may also include forward collision warning) which help to avoid or mitigate rear-end crashes both at high and low speeds. This will be followed in 2016 with the inclusion of Pedestrian Detection technology (as part of the Pedestrian Protection assessment).

### Rewarding new technologies: Euro NCAP Advanced

Since 2010, Euro NCAP has been rewarding vehicle manufacturers that make available new technologies which have a scientifically proven safety benefit for consumers and society but are not yet considered in the rating scheme. Many of these technologies focus on avoiding crashes by informing, advising, alerting or supporting drivers in dangerous situations. Recognising these advances under Euro NCAP Advanced provides an incentive to manufacturers to accelerate the availability of new safety equipment across their model ranges, helps vehicle buyers factor these features into their purchasing decisions and paves the way for inclusion of these technologies in the rating scheme (Figure 3).



Figure 3. In 2010, Honda was presented with one of the first Euro NCAP Advanced rewards for their Collision Mitigation Brake System (CMBS) technology.

## Driverless cars

The idea of automated and self-driving cars has been widely aired in technical discussions and in media coverage recently. The rapid development of electronic safety systems has made the concept possible and prototype systems are able to “drive” in controlled situations. The established vehicle industry is active in this field but new players such as Google have also shown prototypes. There is no doubt that greater automation will lead to a revolution in safety, putting it above all other requirements and characteristics of a car. Not only will the self-driving car have the technology to sense, avoid and mitigate in potential crash scenarios, it will also drive in a safer manner. Besides that, used in a manual way, the vehicle will always carry the safety elements and technologies to intervene when necessary. Euro NCAP plans to engage in the roll out of vehicle automation as a way to dramatically improve vehicle safety and safe driving. It will continue to promote best safety practice when vehicles start to have elements fitted which support automated driving and to ensure that the vehicle manufacturer remains responsible for safe operation of the system.

### Changing the rating

Each year, the development and updating of test and assessment protocols constitutes a significant effort by Euro NCAP, its members and their laboratories. Through its assessments Euro NCAP promotes “best practice” and the state-of-the-art in safety design, often looking beyond what is available on the market today. For this reason, it has over time involved key representatives from the vehicle manufacturers, suppliers and, occasionally, third parties in the development of new procedures.

The development process for new procedures has evolved over the last years with the aim to provide more transparency and to set reliable and stable targets for industry. Euro NCAP aspires to follow the market closely and reward those vehicle manufacturers who show leadership in safety. Hence, a flexible approach is taken where, for each individual subject, the severity of new test requirements and the potential impact on the vehicle design are carefully balanced with the benefit to consumers and the ability to give credit to industry leaders.

A significant effort is also required to communicate changes in the rating system to consumers. This includes a clear explanation of the meaning of the star rating.

### Challenges in the next five years

New cars today are much safer than they were a decade ago thanks to improved crash test standards, crumple zones, seatbelts and airbags which help protect occupants in a crash. While most occupant safety measures can be

considered mature, more could and should be done to improve their robustness for the general diversity of vehicle occupants and crash scenarios.

Crash avoidance systems can help prevent accidents from happening in the first place. They should be effectively deployed to address the above key accident scenarios, including those that involve other road users and commercial vehicles. Today, the uptake of crash avoidance technology still poses a particular challenge: a large variety of systems are available but only a few are offered as standard. The uptake of optional systems is still low and depends greatly on market incentives. In the coming years, the need for more onboard technologies to support (partial) automated driving will probably make crash avoidance systems cheaper and more cost-effective across the European car fleet.

Besides the price, acceptance and volume of advanced technologies are driven largely by how well consumers understand these features and value them. For this, the vehicle rating must reflect the true contribution of passive and active safety measures to the overall safety performance. The lack of traceability of (the performance of) systems in the market, the complex role of driver behaviour and inconsistency in Human Machine Interface (HMI) applied across industry, all further complicate the important task of identifying the true potential of avoidance technology.

## Notes

1. Before 2009, Euro NCAP published three independent ratings per car: adult occupant protection, child occupant protection (as of 2003) and pedestrian protection.

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# Promotion of traffic safety by NCAP in Japan: aiming to be the safest country of road traffic in the world

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## Introduction

The number of casualties reported to police caused by road traffic accidents is tending to decline in Japan; in 2013, 4373 were killed. However the rate of decrease is getting lower whilst the number of deaths in the elderly is increasing and the number of seriously injured (Severe disability) is staying at the same level. (See figure 1).

On the other hand, the Japanese government has proposed outcomes that make the number of deaths less than 3,000 in 2015 and 2,500 by 2018: aiming to be the safest country of road traffic in the world as represented in the OECD statistics.

## JNCAP efforts and effect

In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is working on the safety of the vehicle technology and road safety policy, by linking three measures. One is JNCAP, and there is collaboration with the National Agency for Automotive Safety and Victims'

Aid (NASVA). (See figure 2). NASVA is a specialised agency in Japan for the victims, supporting those who have been seriously injured by road traffic crashes and also their families financially and mentally. NASVA's service includes an aptitude test for professional drivers and promoting training sessions for operational management personnel. NASVA also provide JNCAP with a fair and neutral point of view, and performance evaluation results are reviewed with technical WG and finalised by experts and academics in the JNCAP steering committee which is held by MLIT and then published. This will expedite the technological development of vehicle high safety performance by the manufacturers. And the published results enable consumers to choose safer cars by emphasising public interest in these safety aspects.

As for the effect of JNCAP, if it were not for safer vehicles on the market today, about 5,000 more deaths would have been reported on our analysis of past 80,000 cases of road traffic accident data in 13 years from the benchmark when JNCAP launched. (See figure 3)

## JNCAP performance evaluation and their characteristics

This section shows the JNCAP framework which carries out mainly five performance evaluations on vehicles:

1. Passenger Protection (Collision safety) performance evaluation,
2. Pedestrian Protection performance evaluation,
3. Seat belt reminder performance evaluation for passenger seat and rear seat
4. Usability evaluation for rear seat belt
5. Brake performance evaluation

For Child restraining system (CRS) performance evaluation, we have been testing by sled and usability test.

## Characteristics of each evaluation

### Passenger Protection (Collision safety) performance evaluation

Two kinds of frontal collision test, offset and full-frontal, side impact collision test using MDB, neck protection performance test (whiplash test) by sled are carried out. In the three collision test, protection against electric shock is also evaluated by inside and outside of the vehicle that

uses a high voltage battery on electric vehicles or a hybrid vehicle.

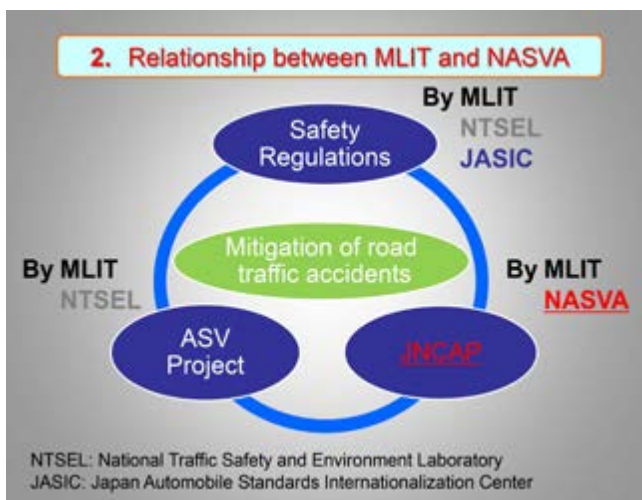
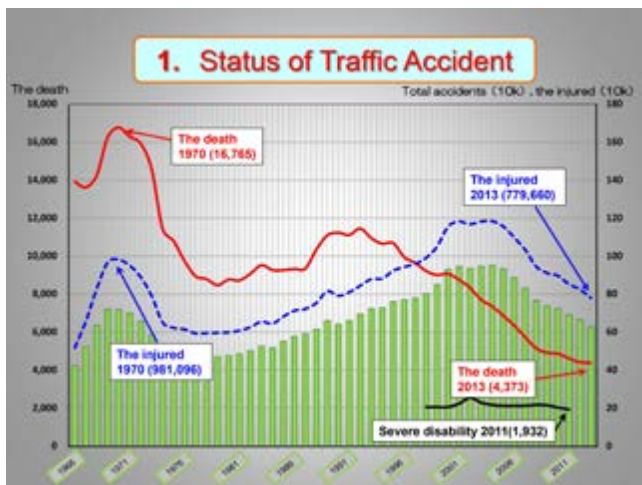
We place an AF05 female dummy on the rear seat in the offset collision test and inspect chest deformation and submarine phenomenon in order to define the occurrence of the lap belt coming off from the proper position (pelvis). Women and the elderly are often seated in rear seats in Japan. In addition, it is observed that a passenger who is wearing a seat belt is more likely to be killed with abdominal (cavity) bleeding because of this submarine phenomenon. This evaluation was adopted as the number of fatalities is reported to be increasing in real world accidents.

In a recent JNCAP result, one model has rated as level one, as this evaluation is difficult to gain points. Recent trends show vehicles equipped with pretensioner system and force-limiter system or both on rear seats gain good points. The effectiveness of JNCAP here is obvious. The model which has got a level one result took a so called “revenge test” after they made some improvements in their design for safety performance and got better points.

### Pedestrian protection performance evaluation

The reduction rate of pedestrian casualties stays flat while the total number of killed on the road is declining. Car occupants and pedestrian deaths figures have reversed in 2008 and the gap between them is growing. JNCAP has been working on Pedestrian Protection performance evaluation and are taking this issue quite seriously. Head and leg impactors are used in the test. JNCAP consider further improvements in pedestrian safety by introducing higher test speeds of impactors.

In a recent result of JNCAP, a vehicle equipped with a pop-up bonnet designed to reduce head injury by popping up the bonnet in a collision with a pedestrian, achieved high points. We can see diffusion in the Japanese market as the result of JNCAP.



## Seat belt reminder performance evaluation for passenger seat and rear seat

The seat belt reminder system with the driver seat is mandatory in regulation in order to alert drivers to fasten their seat belt. The rate of fastening seat belts in the front seat has gone up since penalties have been applied in the road traffic laws. On the other hand, a growing number of casualties are reported for rear seat passengers who have not fastened their seat belt. Considering this situation, JNCAP has carried out seat belt reminder performance evaluation also on rear seats.

In recent result of JNCAP, a vehicle equipped with a rear seat belt reminder system achieved high points.

## Overall safety performance evaluation

Performance evaluations as described above are published with five-star ratings which are easy for the general public to understand. And it is characteristic of JNCAP that Passenger Protection performance and Pedestrian Protection performance are equally evaluated. Each part has 100 points as full marks, so Pedestrian Protection performance has more significant weight compared with other NCAPs in the world.

## Other evaluation

JNCAP has also carried out other evaluations such as seat belt usability evaluation and brake performance evaluation. In 2013, 16 models were evaluated at JNCAP including reverse tests as mentioned above.

## New activity of JNCAP

### Introduction of performance evaluation for Advanced Safety Technology

The performance evaluation for Advanced Safety Technology, Autonomous Emergency Braking System (AEBS) and Lane Departure Warning System (LDWS) are on schedule from 2016. The AEBS performance evaluation test procedure refers to Euro NCAP procedures but evaluation methods are modified with consideration of Japan's situation in road traffic crashes. For example, the speed of a tested vehicle is defined up to 60 km/h which covers most road accidents and a function of Autonomous Braking could be evaluated equally with a function of alert for the driver.

LDWS performance evaluation refers to US-NCAP and is modified with the consideration of Japan's situation, too.

As for the characteristics of JNCAP, the result of evaluation for Advanced Safety Technology would be published separately from existing JNCAP results of overall safety performance evaluation; and a point of performance evaluation for each system (now only AEBS and LDWS in 2016) could be integrated. Using integrated scores, we

are aiming to promote a diffusion of Advanced Safety Technology of the first stage. In addition, we had made a road map for Performance evaluation for Advanced Safety Technology to introduce any other technology and expand with integrated scores. (See Figure 4)

## Promoting JNCAP activities

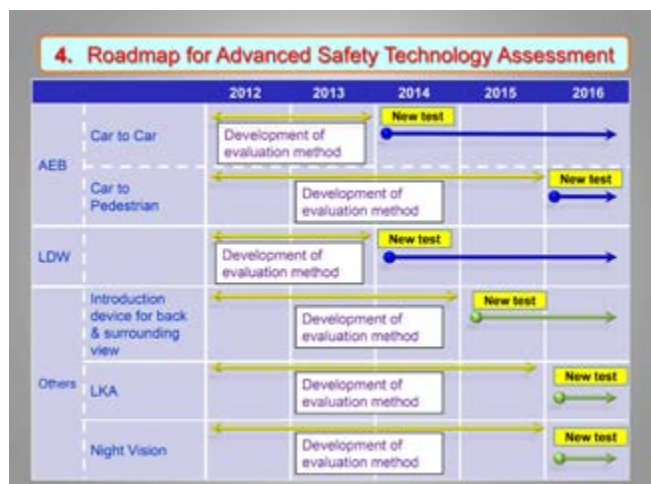
NASVA have been working on public relations in order to gain more recognition of JNCAP activities for its practical use. This includes an open day for collision testing and supporting rescue drills by providing post-crash vehicles. It is effective for rescue teams to use the latest vehicle or hybrid car mounted high voltage battery.

## Conclusion

Over the next few years, JNCAP will focus on evaluation for advanced safety technology i.e. AEBS and LDWS. Manufacturers are developing autonomous technology. It takes time to get these systems to perform reliably. We therefore think it will take significant time before we see fully autonomous driving systems. For the time being, there will still be many road accidents so continuous effort to improve road traffic safety is crucial. NCAP's unique measures generate great power by co-operating with government, academics, industry and the public. Henceforth JNCAP should be implemented even more with the leadership of government in Japan. And in spite of some difficulties because of the necessity to reflect regional road futures and road accidents, it could be useful to see more co-operation with NCAPs globally - especially exchanging their information and experience. Between Australasian NCAP and Japan NCAP, this information sharing could be particularly meaningful because many of the same vehicles are being used in each road traffic area.

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# Overall rating system in KNCAP and the further enhancement roadmap

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## Introduction

The main aims of the New Car Assessment Program in Korea (KNCAP) established by the Ministry of Land, Infrastructure and Transport in 1999 are to provide information on vehicle safety performances; develop competition in vehicle categories with a star rating system; as well as providing safety scores to the consumer who intends to buy a new vehicle in order to help in buying a safer vehicle. The second intention is a driving force to promote the auto makers to build the best and safest vehicles that they can. These philosophies are believed to be one of the most effective vehicle safety policies in reducing the social cost and physical (lives and property) loss in the event of traffic accidents.

Currently, the national target for reduction of fatality is 30% during the five year period (2013-2017). To achieve the national target, KNCAP, the most effective tool for enhancing vehicle safety, should be enhanced and expanded. From statistical analysis of traffic accidents, it must be determined what types or patterns of accident and severe casualties most frequently occurred on the roads. With weighting factors in terms of national safety priorities, KNCAP can be enhanced to reflect the real road vehicle safety problems.

In 2011, the United Nations launched the UN Decade of Action for Road Safety (2011-2020) Plan. Improved vehicle safety is a one of five main pillars of the Global Plan for the Decade in reducing 50% of traffic related fatalities. The Plan recommends that UN Member States apply minimum crash tests standards and establish regional NCAPs. Also, the United Nation's General Assembly adopted a resolution on road safety which encourages "the implementation of new car assessment programmes in all regions of the world

in order to foster availability of consumer information about the safety performance of motor vehicles."

In road safety, the first step in the process is identifying significant safety areas and the mechanisms of accidents and/or injuries that govern the problem. Korea also prescribed as law the establishment of a five year national strategic plan to reduce traffic accidents. Currently, it is now in the second phase of the plan (2013-2017), targeting reduction of 30% of traffic fatalities during the five year period. To meet the national target, KNCAP, the most effective tool for enhancing vehicle safety, should be enhanced and expanded. From statistical analysis of traffic accidents, it must be determined what types or patterns of accident and severe casualties most frequently occurred on the roads. With weighting factors in terms of safety priorities, KNCAP can be enhanced to reflect the real road vehicle safety problems.

## Statistics and analysis of traffic accidents

### Traffic accident statistics

From an economic point of view, in the area of automotive production, Korea is now one of the top ten countries globally including: seventh ranking in exports, tenth in trade volume and fifth in vehicle production volume. However, according to global statistics in road safety, Korea was ranked 29th of 32 OECD countries in 2011. The number of deaths per 100,000 populations was 10.5 (OECD average 6.8) persons and the number of deaths per 10,000 vehicles was 2.4 (OECD average 1.2) persons.

From police reports which counted only injuries involved in road traffic accidents in 2012, the total number of accidents were 223,656 cases, 5,392 deaths (within 30 days), and 344,565 injured persons were reported. As shown in Figure 1, fatalities involved accident patterns which can be classified by 1,997 deaths from car-to-pedestrian accidents (37.0%), 2,156 deaths from car-to-car accidents (40.0%) and 1,256 deaths from single vehicle involved accidents (23.3%); and rail crossing type accidents involved three deaths in 2012. According to classification by types of road user, fatality can be categorised with 2,027 (37.6%)

deaths from pedestrians, 2,090 (38.8%) deaths from vehicle occupants, 908 (16.8%) deaths from motorcyclists, 286 (5.3%) from bicyclists, and 81 (1.5%) deaths from other types of road users as shown in Figure 2. The passenger vehicle involved 49.7% of all fatal accidents while trucks were 22.8% and 12.1% were represented by motorcycles.

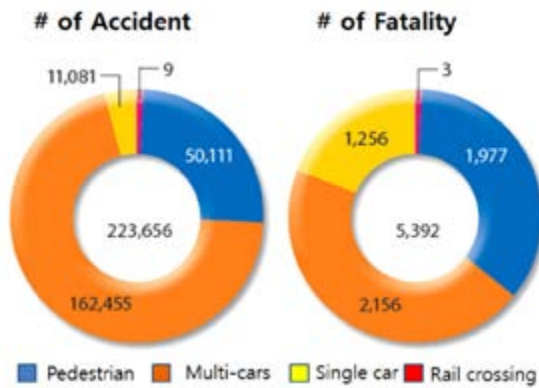


Figure 1. Fatalities by accident types in 2012

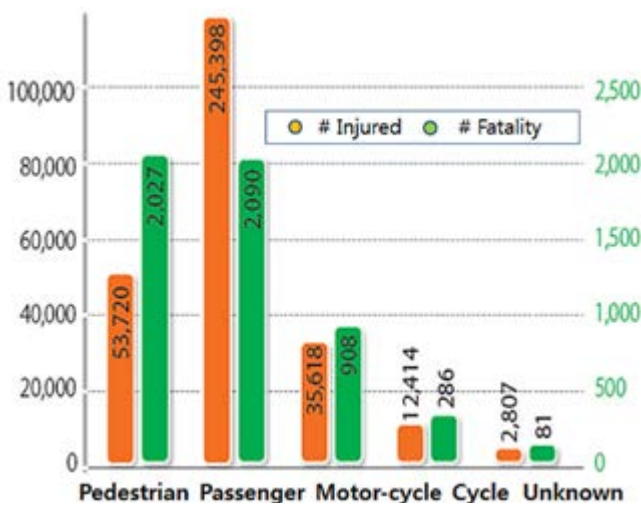


Figure 2. Fatalities by road users in 2012

According to the detailed analysis, head-on collision was shown to have the most fatal severity rates. The fatality rate was 4.6 deaths out of 100 accident cases. While side collision showed 1.1 deaths ratio, rear collision while driving was 1.3 deaths ratio, rear collision while parking was 1.1 deaths ratio as shown in Figure 3. It was also noticed that the ratio of female drivers involved in accidents and the fatality of female drivers was continuously increased. In 2012, 16.6% of traffic accidents were caused by female drivers. The female driver’s fatality rate has reached up to 9.3%. (See Figure 4).

One of the most serious road traffic safety issues now faced in Korea is the dramatically increasing fatality rates of elderly drivers. In 2012, the number of accidents which were caused by elderly drivers were 13,583 cases (6.1%) and 605 elderly drivers were killed (11.2%). The fatality

ratio (4.5) was 1.7 times higher than overall fatality ratios (2.4). From the injured accident analysis, 46.3% of all injured accidents were neck injury by rear collision type accidents. The child injury involved accident rate was 4.5%.

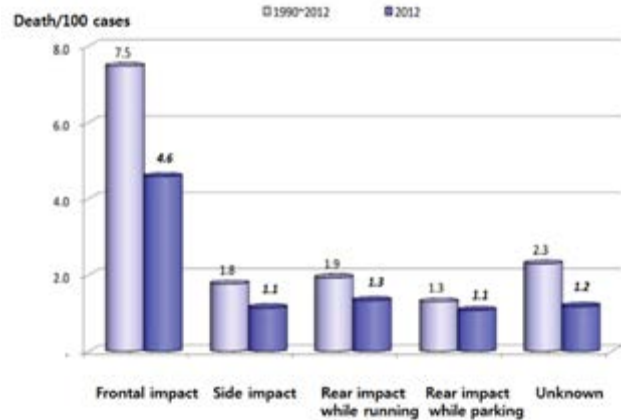


Figure 3. Fatal severity ratio in car-to-car accident in 2012

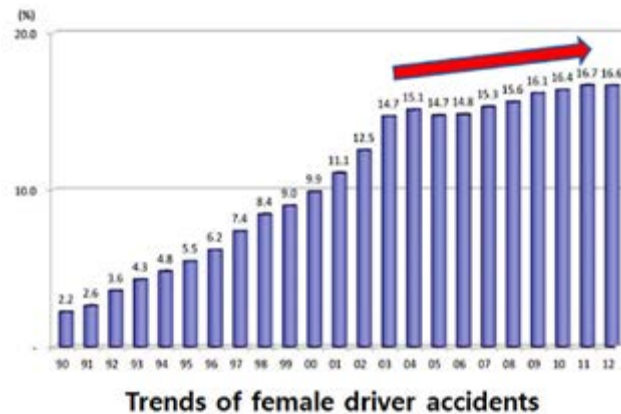


Figure 4. Trends of female drivers involved in accidents

### Statistical analysis of traffic accidents

Results from the statistical analysis of the 2012 road traffic accident database can be characterised as follows:

- Car-to-car accident is the most frequent type of collision and severity ratios differ from the type of accidents.
- Higher pedestrian fatality is still a serious problem.
- The number of female drivers involved in accident and fatalities are continuously increasing.
- The number of elderly drivers involved in accidents, deaths and injury are rapidly increasing.
- WAD related injury is the most dominant type of injury pattern.
- The number of injured children in vehicles can't be ignored.



## Enhancement of Korean New Car Assessment Program

MLIT has been conducted for a total 118 vehicles (112 passenger cars, four small buses, two trucks) during 1999 - 2013 according to four safety fields: vehicle crash safety; pedestrian protection; rollover prevention and braking performance; and vehicle active safety.

In 2013, the overall rating system in KNCAP has been launched to help the consumer's to understand excellence of safety performance categorised by five different Class systems (1st Class, 2nd Class, 3rd Class, 4th Class, and 5th Class). Since 1999, KNCAP started only three vehicles were tested in the full wrap frontal impact test, but it has been continuously expanded and enhanced to nine different test protocols as shown in Figure 5.

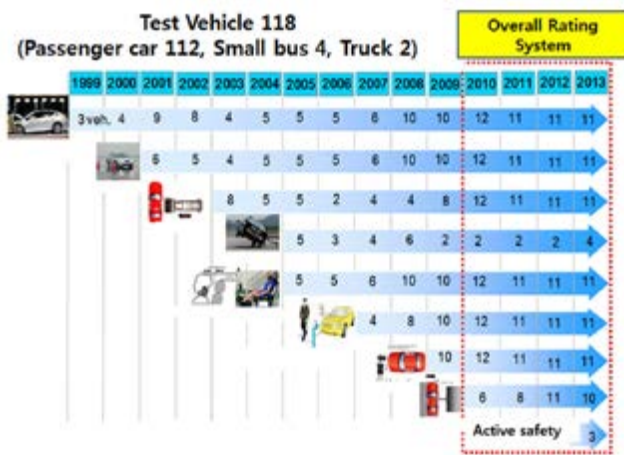


Figure 5. History of KNCAP and expansions

### Overall rating system

KNCAP conducts nine different test protocols including the frontal crash test, side crash test, pedestrian head and leg tests. All nine test results of each individual vehicle will be integrated and overall points calculated (maximum 100 points). With the final points, each vehicle's safety rating can be determined between Class 1 to Class 5 ranges. The test methods and assessment criteria are as follows:

#### A. Assessment fields (four categories)

- Vehicle crash safety: full wrap frontal impact test, offset frontal impact test, side impact test, side pole impact test, and rear impact sled test.
- Pedestrian protection: pedestrian head and leg impact test.
- Rollover prevention and braking performance: braking tests, rollover stability test.
- Vehicle active safety: seatbelt reminder test.

#### B. Evaluation

- Add points of each category's test results and convert into a percentage.
- Multiply converted percentage by weighting factors (see Table 1).
- Classified Class grade based on final points (see Table 2).
- Check minimum required percentages in both vehicle crash safety and pedestrian protection (see Figure 6).

Table 1: Weighing factor for overall rating system

Assessment field	Weighting factor (%)
Vehicle Crash Safety	65
Pedestrian Protection	25
Rollover prevention and Braking performance	10

Table 2: Overall rating criteria and minimum required points

Overall Rating Criteria		Minimum required points		
Class	2013(pts)	Class	Vehicle Crash Safety (%)	Pedestrian Protection (%)
1	83.1~	1	90.1~	50.1~
2	80.1~83.0	2	87.1~90.0	40.1~50.0
3	77.1~80.0	3	84.1~87.0	35.1~40.0
4	74.1~77.0	4	81.1~84.0	30.1~35.0
5	~74.0	5	~81.0	~30.0

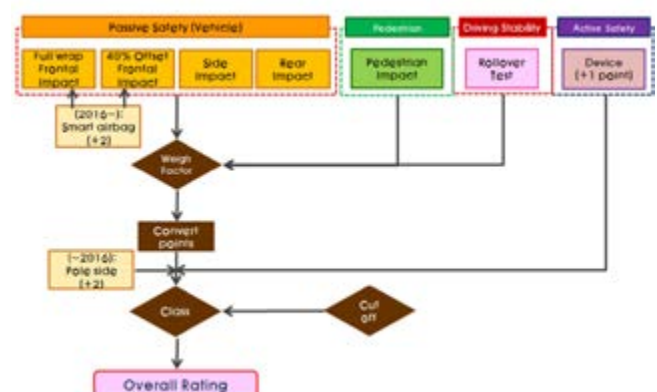


Figure 6. Overall rating process in KNCAP (2013-)

#### C. Labelling and promotions

It is very important that test results are made easier and more understandable to consumers. In KNCAP, the assessment of individual vehicles consists of overall class ranking and each four category grading systems. As shown

in Figure 7, each assessment result can be visualised to improve clarity. The detailed data is available to the public through websites [www.car.go.kr](http://www.car.go.kr) or [www.ts2020.kr](http://www.ts2020.kr) or mobile phone application [m.car.go.kr / kncap](http://m.car.go.kr/kncap).



Figure 7. Labelling of overall rating for each vehicle

### Effectiveness of KNCAP

Historically governments and research organisations have used the traditional statistical approach to assess benefits of safety programs such as NCAP or safety devices using in-depth crash data which normally allows a more detailed level of analysis. In Korea, publicly available accident data is only published through police reports rather than allowing direct access to the detailed raw database. Current Korean in-depth accident databases for research purposes have a limited number of cases and are still in the early stages. In this study, as an alternative, the improvement of vehicle safety in terms of KNCAP rating was compared with tested vehicles in chronological order.

For frontal crash tests, the average combined serious injury risk probability (AIS 4+) for the first three years of vehicle testing (1999-2001) was 21.6%. Safety performances have been significantly improved in the last three years (2011-2013) - the average  $P_{comb}$  value was decreased to 15.1%. In results from side crash test analysis, the probability of serious injury (AIS 3+) was 11.3% in 2003. In 2013, the value was dramatically dropped to 2.0% as shown in Figure 8. In the Side pole impact case, potential serious injuries (AIS 3+) were 95.6% in 2009 and also dropped to 8.9% in 2013 (see Figure 9). The Side pole crash test was added in KNCAP protocol as an optional test which manufacturers can choose to get a maximum additional two points from this extra test. Within four years, even though the side pole test was initiated as an optional test, most vehicles have recently been equipped with side curtain airbag as a standard option. In addition, it was clearly proven that a side curtain airbag is a most effective safety device to protect occupants from the side pole collision type accidents.

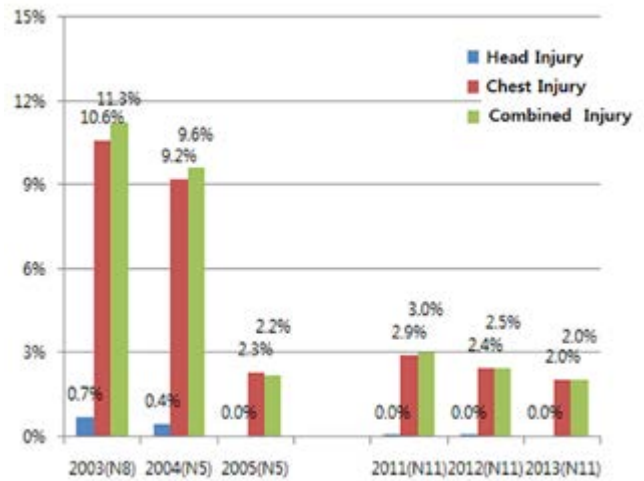


Figure 8. Improvement of side crash safety

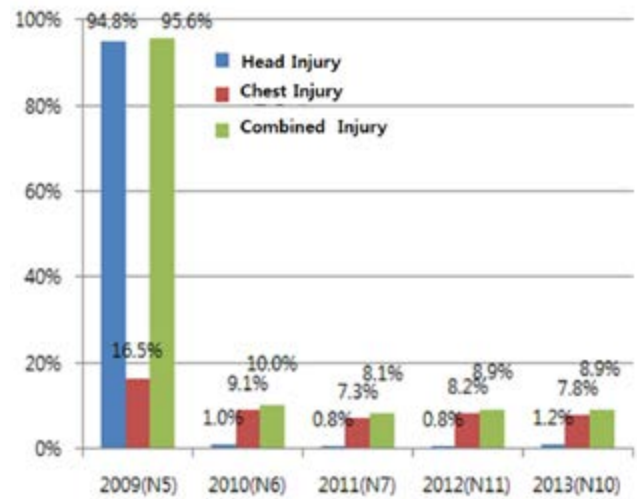


Figure 9. Improvement of side pole crash safety

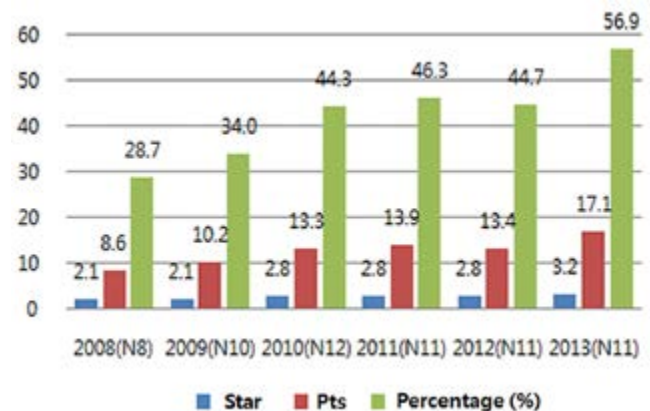


Figure 10. Improvement of pedestrian safety

Pedestrian safety in 2013 compared to 2008 was improved nearly twice as much (see Figure 10). However, pedestrian accidents and higher fatality rates are big issues which leave plenty of room for improvements in KNCAP.

## KNCAP Roadmap (draft)

In Korea, KNCAP has been established to evaluate vehicle safety performance to reduce the number of traffic deaths, serious injuries as well as the number of accidents. The KNCAP roadmap must be reflected in national traffic accident statistics. Also more care is needed for vulnerable

road users such as children, women, the elderly and pedestrians. The draft KNCAP roadmap emphasises protection of vulnerable rear seat occupants and promotion of active safety technology.

Plans include in 2014: Active pedestrian protection test; and after 2017: enhancing side impact safety, seatbelt reminder (two-row seats expand), speed limiter, female drivers, children (6 years old, 10 years old) in front and side impacts, automatic cruise control, drowsiness prevention, blind spot detection, monitoring drunk driving, lane-keeping support and automatic emergency braking systems.

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# The First four years of Latin NCAP: short time, great progress in the LAC market

by Alejandro Furas

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Since 2010 Latin NCAP has been testing the most popular vehicle models available in Latin America. It was demonstrated that Latin America's best selling models are 20 years behind Europe, US, Japan and Australia in terms of vehicle safety. After four years and more than 35 models tested, finally the region is beginning to have popular cars offering the highest safety levels.

The most basic equipped versions, which are the ones selected by Latin NCAP, showed that the absence of airbags exposed the passenger dummies to serious injuries. The structural performance of the passengers' compartment was weak to poor in the best selling models of Latin America. That meant that at least 450,000 new cars every year were sold with 1 and 0 star safety levels.

Latin NCAP has also had to deal since its beginning with the lack of technical regulations for vehicle safety performance under frontal or side crash situations. This situation offered Latin NCAP an extra challenge still under development.

Latin NCAP tested cars - even with airbags - being sold in the region and they still offered low protection levels to its occupants due to weak structures. One powerful result that can illustrate the risks of an unstable structure even with two airbags and pretensioners is the JAC J3 that scored only one star in adult occupant safety.

Some governments in the region are requiring airbags by law and the previous example shows clearly that airbags alone may not solve the problem and that a performance requirement is needed. Some countries in the region are focusing on the introduction of performance criteria regulations.

Cars with no airbags showed high risk of life threatening injuries for passengers. In cases where the same model was tested with and without airbags, the benefit of the airbags was clear in the result bringing some models from one to three stars, and another from one to two stars. This also shows that there is room for improvement in some cases with not very dramatic changes needed to make the cars perform better in the test.

Latin NCAP also compared models tested in our program to the same models tested by other NCAPs such as Euro NCAP. There is a clear difference in safety equipment of the same models; like less airbags, no ABS or no ESC for example. But we have seen cases where the structures of two same looking models behave in a very different way. Examples of that are the Nissan March compared to the Nissan Micra, or Renault Sandero and Dacia Sandero. In those cases the Latin NCAP structure was rated as unstable and intrusions were higher as well.

Latin NCAP received comments from consumers claiming that the airbag versions of the models tested are much more expensive than the basic, non-airbag version. In some cases the consumer must pay from 18% to 33% on top of the basic price to get just double frontal airbags. In some cases this is explained by the “package” that offers the manufacturer matching airbags with other non-safety related items like Bluetooth or alloy wheels.

In one sample case of the same European model but different structural behaviour, having the Latin NCAP model with no airbags, but the European model six airbags, ABS and ESC the price difference at the same time between those cars (one sold in Europe and the other sold in Latin America) was less than 1000 Euros. However these price differences are strongly linked to the local taxes. Cars in Latin America are as or more expensive than in Europe and they offer a lower level of occupant protection. Some consumers are wondering why this is happening and how it can be fixed.

Latin NCAP compared a model to the identical car offered in Europe: Nissan March (Latin America tested by Latin NCAP) and Nissan Micra (Europe tested by Euro NCAP).

Both cars were compared only in the frontal crash test. Both have double frontal airbag.

A post-test technical comparison showed differences in the structures of both cars which explained differences in the car’s occupant protection performance.

In order to make a more global analysis, in June 2012 Latin NCAP explored the market of this car in terms of prices and equipment and found the following results:

		Values in €URO\$					
Structure	Icon	ARG	BRA	COL	URU	GER	FRA
March		N/A	N/A	10,469	13,397	N/A	N/A
			+3,416	33%	18%	+2,403	
March		13,420	9,900	13,885	15,300	N/A	N/A
Micra		N/A	N/A	N/A	N/A	10,840	10,590

This table shows that to get a double airbag in this car in markets like Uruguay and Colombia the consumer must pay more than 18% more than the basic price which means more than 2400 Euros, but in Colombia this increase goes up to 33% which means more than 3400 Euros.

Compare the prices of the Latin American car, which has a weaker structure and no more than two airbags versus the European model which cannot be purchased with less than two front airbags, two side airbags, two curtain airbags, ABS and ESC. In Germany this model is less expensive than a less safe Latin American car in Argentina, Colombia or Uruguay and less than 1000 Euros more expensive than in Brazil.

The reason for these price differences can come from taxes as well as from higher prices from the manufacturers to sell the car in Latin America. For any of these reasons, Latin American consumers of small cars - that in general earn lower wages than the European population per month - are forced to pay much more for a much less safe car. Manufacturers and the Government should review this fact in order to balance this situation to enable safer cars to be available in Latin America at lower prices.

Latin NCAP also analysed the case of comparing the Dacia Sadero (Europe) and Renault Sandero (Latin America). The comparison here focuses on the structure of both cars that look the same but are built in different plants.



*Sandero: Comparing the same model from different plants, the difference in bodyshell stability can be clearly noticed.*

Until Phase 3 of Latin NCAP testing in 2012, the models that could offer a four star level of safety to their occupants were large and expensive models. However, the Toyota Etios showed that a car from the small most competitive market in the region can offer four stars in adult occupant safety and be sold for a price close to the 10,000 Euros in Brazil as well as being locally produced.

After the latest introduction of protocol changes in 2013, adding requirements to reach the five star score, some manufacturers reacted and begun to offer five-star models. At the early stages all models with five stars were expensive models until December 2013, Volkswagen introduced the VW up! made in Brazil. A bit different than the European version with a larger fuel tank, longer trunk, taller suspension, larger wheels and metal trunk door, the up! was assessed and reached five stars in adult occupant protection and four stars in child occupant protection. The up! is the first car in the Latin NCAP market from the compact segment reaching the five star result.

Latin America is composed of emerging economies. Unfortunately some manufacturers present to this market “low cost cars” that offer low to no safety levels. Recently Latin NCAP presented two price comparisons that showed

that the so called “low cost” models other than offering very low safety levels do not seem to be so “low cost” compared to European models with high basic safety.

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## The CITI Project - Australia’s first Cooperative Intelligent Transport System Test Facility for safety applications

by John P Wall<sup>1</sup>, Paul Tyler<sup>2</sup>

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### What are Cooperative Intelligent Transport Systems and how will they benefit Australians?

Cooperative Intelligent Transport System (CITS) is the term generally defined as a form of Intelligent Transport in which information is shared amongst vehicles or between vehicles and roadside infrastructure such as traffic signals.

Sophisticated CITS applications have been developed that increase the “time horizon” as well as the quality and reliability of information available to the drivers about their immediate environment, other vehicles and road users. This has the potential to greatly improve road safety, reduce greenhouse gases and improve network efficiency.

Whilst a number of communication platforms such as the 3G or 4G mobile phone network can be used to carry communications between vehicles and roadside units, specific dedicated short range radio channels in the 5.9 GHz area of the radio spectrum are planned to be used by most major jurisdictions overseas. In Australia, use of the 5.9 GHz band is currently embargoed and the Australian Communications and Media Authority (ACMA) has recognised its future potential use for CITS, however a final determination on the use of the spectrum and its licensing is yet to be made (NTC 2012).

### The road safety benefits of Cooperative ITS

The United States Department of Transport in their white paper on CITS has estimated that up to 82 percent of all crashes by unimpaired drivers could potentially be addressed by vehicle to vehicle (V2V) technology. If V2V were in place, another 16 percent of crashes could potentially be addressed by vehicle to infrastructure (V2I) technology.

Austrroads conducted a study into the potential road safety benefits of vehicle to vehicle dedicated short range communications (DSRC) in September 2011. The report found that the current total of approximately 29,000 annual serious casualties could be reduced to between 18,500 and 21,500; a reduction of 25-35 per cent (Austrroads 2012). A serious casualty includes road users that are killed or seriously injured as a result of a road crash.

### Other benefits of Cooperative ITS

The National Transport Commission also reports that overseas studies indicate that significant environmental and productivity benefits may also result from the deployment of CITS applications.

### The CITI project

#### Location

The CITI project is proposed to cover a 42 km length of road that connects the Hume Highway in Sydney’s South West to Port Kembla situated two kilometres south of Wollongong Central Business District.

Heavy vehicles were involved but were not necessarily at fault in 69% of the fatal crashes recorded on the proposed route in which 13 people were killed (Over a three year period up to 30 September 2011). Significant engineering safety works have been carried out along the Picton Road section of the route since 2011, including road widening and flexible crash barrier deployment.

#### Type and number of dedicated short range communication devices within the project

The first stage of the project proposes to fit in-vehicle dedicated short range communication (DSRC) transceivers