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Invited review

The European New Car Assessment Programme: A historical review

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ABSTRACT

Established in 1997, the European New Car Assessment Programme (Euro NCAP) provides consumers with a safety performance assessment for the majority of the most popular cars in Europe. Thanks to its rigorous crash tests, Euro NCAP has rapidly become an important driver safety improvement to new cars. After ten years of rating vehicles, Euro NCAP felt that a change was necessary to stay in tune with rapidly emerging driver assistance and crash avoidance systems and to respond to shifting priorities in road safety. A new overall rating system was introduced that combines the most important aspects of vehicle safety under a single star rating. The overall rating system has allowed Euro NCAP to continue to push for better fitment and higher performance for vehicles sold on the European market. In the coming years, the safety rating is expected to play an important role in the support of the roll-out of highly automated vehicles.

Over the last decade, the European New Car Assessment Programme (Euro NCAP) has become synonymous with crash testing and safety ratings. In the same period, the total road death toll in EU-28 has been reduced by roughly a quarter, despite a significant growth in road traffic volumes.[1] One important factor is that cars in Europe have become much safer, partly due to the vehicle industry's response to initiatives such as Euro NCAP.

Euro NCAP provides motoring consumers with a realistic and objective assessment of the safety performance of the most popular cars sold in Europe. At present the organisation has 12 members representing the citizens and consumers in the whole of Europe. These include the member state governments of the United Kingdom, Germany, France, Sweden, the Netherlands, Luxemburg and the regional government of Catalonia, the International Automobile Federation, motoring clubs (Allgemeiner Deutscher Automobil-Club (ADAC) and Automobile Club d'Italia), Consumers International and the Motor Insurance Repair Research Centre Thatcham. In the 18 years of its existence, Euro NCAP has published ratings on over 500 different vehicles, including superminis, family cars and multi-purpose vehicles, roadsters, sport utility vehicles, pick-up trucks, hybrids and, recently, full electric vehicles.[2]

This retrospective paper presents a historical overview of the Euro NCAP programme from its beginning in 1997 to today and investigates the impact which the programme has had, and still has, on the proliferation of safer vehicles on the European market and elsewhere. It also explores the future of vehicle safety and discusses what role the safety rating body is intending to play in the next years.

The origins of consumer testing in Europe

Since the early seventies, a number of European governments have, through the European Experimental Vehicles Committee (EEVC),[3] collaborated on the development of test procedures and equipment to assess various aspects of car crash safety. By the

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middle of 1990s, this research had resulted in completely new full scale crash test procedures for protection of car occupants in frontal and side impacts, and a component test procedure for assessing the protection of pedestrians hit by the fronts of cars. At that time, the only full scale crash test required by European legislation was a full width rigid block impact designed only to control intrusion of the steering column in a frontal crash.

In 1979, the National Highway Traffic Safety Administration started the New Car Assessment Programme (NCAP),[4] where cars were frontal impact tested at the impact speed of 35 miles per hour. In Europe, the German motor club ADAC and the motoring magazine *Auto Motor und Sport* started to perform offset rigid wall frontal crash tests and to publish the results as consumer information. At around the same time, a single series of frontal tests, jointly funded by the UK Department of Transport (DfT) and International Testing and using the EEVC offset deformable frontal impact test procedure, were published.[5] These programmes highlighted the beneficial effects that consumer information could offer and got the ball rolling for a permanent programme for the whole of Europe.

In November 1996, the Swedish National Road Administration (SNRA), the Federation Internationale de l'Automobile (FIA) and International Testing were the first organisations to join in the UK DfT with the newly formed Euro NCAP.[6] Taking as a starting point, the same EEVC procedures that would form the basis of future legislation, dedicated test and rating protocols were developed for front impact and side impact (including 3-year-old & 18-month-old dummies in manufacturer's recommended child restraint systems) and for pedestrian protection. The first results on seven superminis were presented at TRL in the UK in February 1997. The release of these first results caused considerable media interest, fuelled by a strong critical response from some of the car manufacturers.

In October 1998, new directives, based on the EEVC's recommendations, concerning frontal and side vehicle impact (96/79/EC and 96/27/EC respectively) became effective for all new vehicles. In the same year, Euro NCAP achieved legal status when it became an International Association under Belgian law. From the formation of Euro NCAP, the FIA took the lead in promoting the programme and in discussions with other potential members. As a consequence, more European governments, automobile clubs and representatives from the insurance industry have joined Euro NCAP over the years. Operational control of Euro NCAP moved from the UK to a full time secretariat based in Brussels in 1999.

The evolution of vehicle safety

From 1997 onwards, new batches of test results were published about twice each year and car manufacturers, setting aside their initial reservations, started to sponsor the testing of their own cars. As new car models replaced those already tested, the improvements in their occupant star ratings could be clearly seen (Fig. 1). In June 2001, the Renault Laguna became the first car to be awarded 5 stars for occupant protection, made possible by the introduction of the pole test (see section below). Following from this success, manufacturers increasingly saw 5 stars as the goal for all their new models.

The first period of Euro NCAP testing was coincided with the introduction of the first realistic crash tests in European legislation. Consequently, the vehicle safety standard in industry was evolved at a fast pace, in particular in occupant protection. From the beginning, it was intended that Euro NCAP would encourage manufacturers to exceed the legal requirements and this was achieved by applying more stringent and/or additional test conditions and by extending the assessment to new areas of vehicle safety, as illustrated by the examples below.

The pole test

Research has shown that pole side impacts are relatively uncommon, but they represent a disproportionately high level of fatalities and AIS3+ injuries.[7] In the late nineties, car manufacturers started to introduce countermeasures focussed on preventing head and (to a lesser extent) thorax injuries, which together represent the predominant cause of death in such crashes. As head impact did not regularly occur in the barrier test, Euro NCAP added an optional pole test to demonstrate the benefit of the head protecting airbags for side impact. With no appropriate test being developed in Europe, the US side impact pole test[8] was adapted for use with the European side impact dummy EUROSID-1. Using this procedure, the results for the first cars were published in 2000. More recently, Euro NCAP's pole test has seen several updates, including the test dummy, performance criteria and scoring.

Knee protection

One of the most contentious areas of the adult occupant assessment is related to knee protection. The seating procedure for the adult dummies ensures that the knees always hit the same small areas of the facia in the frontal impact test. With this knowledge, manufacturers have generally ensured that these areas are relatively free from hazards. However, accident research showed that crash victims can impact their knees on virtually any part of the facia they can reach. Before Euro NCAP, such areas were untested and frequently contained aggressive structures. Such hazards were frequently found in the region of the steering column.

Euro NCAP examines the whole facia area and penalties are applied to the Euro NCAP score where hazards are found. In 2007, a dedicated “knee mapping” sled procedure[9] has been adopted to help manufacturers demonstrate the safe design of the facia area for different sizes of front seat occupants and avoid penalties.

Pedestrian protection

In contrast to the advances made in occupant protection, improvements in pedestrian protection were initially slow to emerge. In 2002, the European Commission and Association des Constructeurs Européens d'Automobiles reached a voluntary agreement on pedestrian protection[10] but failed to implement the state-of-the-art pedestrian protection subsystem tests developed and validated by EEVC. This left Euro NCAP to deal with an industry unwilling to make the necessary investments to improve vehicle front-ends. Lack of progress was such that at the beginning of 2002, Euro NCAP revised its pedestrian testing and assessment protocols

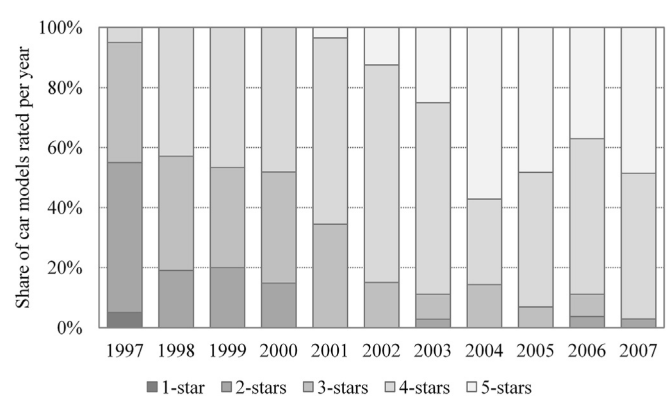

Fig. 1. The evolution of adult occupant star ratings over the first decade of testing.

in an attempt to encourage manufacturers to make improvements. At the same time, new developments reported by the EEVC[11] were also incorporated. Using this revised protocol, some moderate steps forwards were achieved (Fig. 2).

Encouragingly, in 2005, the Citroen C6 became the first car to achieve 4 stars for pedestrian protection. This car was equipped with sensor technology to detect an impact with a pedestrian and to deploy a “pop-up” bonnet to provide greater protection. However the “pop-up” bonnet and other innovations in pedestrian protection remained uncommon until Euro NCAP changed its ratings regime in 2009 and the European Commission Regulation (EC) 78/2009[12] was adopted in Europe.

Child protection

Since May 2006, it has been compulsory to use safety belts and United Nations Regulation No. 44 type-approved child restraint systems in all vehicles in Europe.[13] It is also mandatory to use child car seats within the EU for children up to the heights of 1.35 m or 1.5 m - depending upon the member state. Thanks to these laws and increased consumer awareness and compliance, child deaths in motor vehicle crashes have steadily declined over the last decades.[14]

The European Test Standard for Child Restraints[15] was introduced in 1982. As a consequence, most car manufacturers relied for many years on the makers of child restraints to provide protection for children in cars. Very few offered child restraints through their dealerships or provided any recommendation to their customers, and there were almost no special provisions in the vehicle for the safe transport of children. However, there are many aspects of child protection which cannot be influenced by the child restraint manufacturer alone and require action also on the part of the car manufacturer. For this reason, Euro NCAP introduced an additional star rating in 2003, specifically addressing the protection of children in the event of a crash. The rating was based on the protection offered in the front and side crash tests to a three year old and 18 month old child seated on the rear seat in a restraint of the type recommended by the car manufacturer. The assessment was complemented with firm incentives with regards to communication (handbook instructions, information at dealerships, warning labels, etc.) and availability of ISOFIX attachments and other relevant equipment such as a front passenger airbag deactivation switch. The child occupant protection star rating has motivated all car manufacturers to aim for good child protection and has facilitated a better dialogue between car manufacturers and child restraint suppliers.

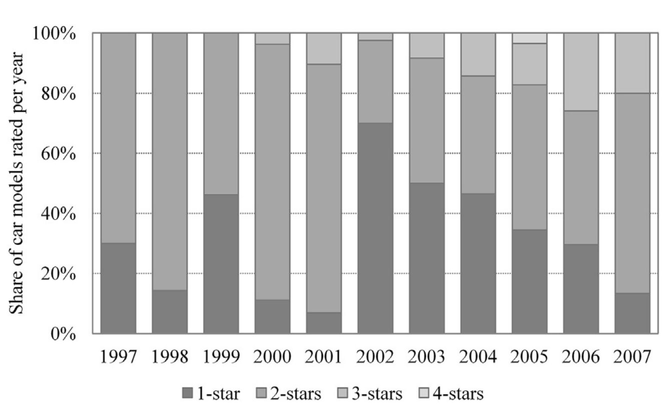

Fig. 2. The evolution of pedestrian protection star ratings over the first decade of testing, showing moderate progress was made after the 2002 protocol change.

Intelligent seat belt reminders

Although Euro NCAP's influence was seen to be improving adult occupant protection, there was concern that this improved protection relied on the proper use of seat belts. As protection for belt wearers improved, accident data increasingly showed that a higher proportion of seriously and fatally injured casualties were not wearing their seat belts.[16] To improve this situation, Euro NCAP developed a protocol to encourage the fitment of Intelligent Seat Belt Reminders (SBR). The protocol was inspired by the work of EEVC related to seat belt reminders.

Research had shown that most non-wearers could be persuaded to use their seat belt if they were given a suitable reminder. Although simple reminders have been available for many years, intelligent systems can be much more effective: almost unnoticed by belt wearers but increasingly aggressive and demanding for those who do not “buckle up”.

For front seats, Euro NCAP requires a “final signal”, which has to be audio-visual and must be presented at the latest 60 s after the engine start, after 500 m of vehicle travel or speeds above 25 km/h. The final signal must last for a minimum of 90 s and consist of a “loud and clear” audible signal and a visual indicator. For rear seats, Euro NCAP requires a “start signal”, which may be visual only. For all seats, if a change in belt status occurs at speeds above 25 km/h, i.e. a belt gets unbuckled, an immediate audible signal must be given.

The first intelligent seat belt reminders were reported by Euro NAP in November 2002. Initially, most systems covered only the driver's seat, with the front seat passenger being covered later. By 2004, Intelligent Seat Belt Reminders were becoming more commonplace, the SBR score being an effective way to improve a car's Euro NCAP rating.

Whiplash

It is well understood that the huge increase in whiplash claims in the last decades were in part the result of the legal system of compensation. Nevertheless, whiplash remains the most frequently reported injury on European roads. As whiplash injury to the neck often leads to long term impairment, with 10 percent of people suffering long term discomfort and 1 percent permanent disability, addressing “whiplash” injuries, their causes and prevention has been an important priority for the European Commission.

Whiplash may occur in all impact directions but the injury is most frequently observed, and its risk most effectively addressed, in rear-ends impacts. For this injury type, no biomechanically based vehicle safety regulations exist, mainly as a consequence of the limited (or inconclusive) knowledge available on whiplash. However, research has demonstrated that, in the event of a rear-end collision, the vehicle seat and head restraint are the principal means of reducing neck injury.[17]

Starting from the assumption that lowering loads on the neck lessens the likelihood of whiplash injury, the first stand-alone tests for seats and head restraints were developed by the International Insurance Whiplash Prevention Group (IIWPG)[18] and the Swedish Road Administration (SRA).[19] However, the tests adopted different philosophies with regards to relevant seat performance parameters, one putting heavy emphasis on real world validation (IIWPG), the other using plausible hypotheses regarding the causes of whiplash injury (SRA).

Euro NCAP set up a Whiplash group in 2002 with the intention of developing a test that could complement the existing whole vehicle consumer crash tests. In 2008, Euro NCAP had completed its work and formally launched the first series of results of (front) seat testing. The procedure itself was adopted as part of the overall rating in 2009.

The advent of crash avoidance

By 2007, the Euro NCAP ratings for adult protection, child protection and pedestrian protection had been in common use for a decade and had become internationally recognised as a reliable indicator of independent consumer information about car safety. Industry's efforts to deliver increasingly safer cars resulted in many able to achieve 5 stars for adult protection. But while this represented a significant step forwards for consumer protection, worries started to rise over the future of the programme.

Firstly, it was clear that the high share of cars rated 5 stars for adult protection was diminishing the discriminating factor in the rating with each advancing year leading, amongst other things, to less media interest in the results. At the same time, the successes in adult protection were hiding the less favourable progress in the other areas such as pedestrian protection from the view of the consumer. But it was the rating scheme's inability to deal with emerging driver-assist and crash avoidance systems that ultimately triggered Euro NCAP to review and fundamentally overhaul its rating system.[20]

The overall safety rating

In 2009, Euro NCAP changed from three individual ratings to a single overall safety rating with a maximum of 5 stars for each vehicle. This overall rating combined the results of assessments in four important areas: adult protection, child protection and pedestrian protection – the three areas assessed in the previous scheme – and the new area of safety assist technology. The underlying tests included the full-scale frontal offset, side-impact barrier and pole tests carried over from the previous adult and child protection ratings, the new seat tests for whiplash prevention in rear-end crashes, and front-end component tests for pedestrian protection. The assessment of Intelligent Seat Belt Reminders was complemented with that of Speed Limiters and Electronic Stability Control as part of Safety Assist. In each area of assessment, scores were calculated as a percentage of the maximum points available and a weighted sum of these scores indicated the car's overall all-round performance.

The “encompass all” overall rating was established to provide a more balanced assessment of various vehicle safety aspects and to add more flexibility to the ratings scheme. It allowed future technologies to be added without the need to add stars or introduce new rating categories. A top achiever would not only have to achieve a high overall score, but could also not underachieve in ensure any single area. Hence, by moving to the overall rating scheme, Euro NCAP was able to promote “integrated” safety solutions, using both active and passive safety technology.

With the overall rating scheme in place, Euro NCAP subsequently worked on a programme of stepwise updates to the rating scheme in following years.[21] During this period, minor and major revisions to the existing crash and component tests were carried through. In addition, new functional tests were added, in particular related to crash avoidance and advanced driver assistance technologies.

Electronic stability control

Crash avoidance technology is aimed at reducing the likelihood of an accident happening or reducing its severity. Research has shown that Electronic Stability Control (ESC) is effective in helping to prevent certain types of (loss of control) crashes, e.g. Lie et al's[22] and Thomas's.[23] Already in 2005, Euro NCAP gave a strong recommendation to consumers that they should specify ESC on any new car purchase. From 2009 onwards, ESC became an integral part of the overall rating, first on the basis only of fitment and later, in 2011, on fitment and functional requirements verified by a series of “sine-with-dwell” track tests similar to those specified in the Global Technical Regulation 8.[24]

Speed assistance systems

Excessive speed is a factor in the causation and severity of many road crashes. In fact, it has a greater effect on the number of accidents and injury severity than almost all other known risk factors.[25] Speed restrictions are intended to promote safe operation of the road network by keeping traffic speeds below the maximum that is appropriate for a given traffic environment. Voluntary speed assistance systems (SAS) are a means to assist drivers to adhere to speed limits, by warning and/or effectively limiting the speed of the vehicle. The only technical requirements for such devices are laid down in United Nations Regulation No. 89 “Speed Limitation Devices”, which is not mandatory in Europe and does not specifically apply to M1 passenger cars.

Since 2009, Euro NCAP has rewarded manually set speed limitation devices which meet the basic requirements of United Nations Regulation No. 89 but have additional functionality with regards to the warnings given and the ability to be set-at-speed. By doing so, Euro NCAP has created a first incentive to manufacturers to promote such speed-limitation devices, to make them available on more models and to fit them as standard equipment.

In recent years more advanced speed assistance systems have been introduced onto the market which are able to inform the driver of the speed limit at the vehicle's current position, based on digital speed maps and/or traffic sign recognition. Although there are still limitations to these technologies, intelligent speed assistance systems have much greater potential and will be more readily acceptable to the public. As a result, Euro NCAP extended the speed limitation protocol in 2013 to include the latest generation of intelligent speed assistance systems.

Autonomous emergency braking

Autonomous Emergency Braking (AEB) is without doubt the most important active safety systems that Euro NCAP has adopted since ESC. Using technologies such as radar, lasers and optical sensors to identify other vehicles and in many cases pedestrians, AEB automatically applies the brakes if the driver does not respond in time, to avoid or mitigate a collision, saving countless lives, injuries and inconvenience. Systems are most effective at lower speeds (<40 km/h) where more than 75% of rear-end crashes occur, but they are also effective in mitigating the devastating effects of higher speed crashes.

Within Europe, four main initiatives have actively contributed to development of test procedures for assessing AEB and forward collision warning (FCW) systems for car-to-car crashes. ADAC, with support from automotive suppliers Continental and Bosch, developed an inflatable vehicle target[26] in order to perform a comparative test of AEB systems on high-end vehicles. The RCAR Autonomous Emergency Braking group,[27] led by Thatcham, designed a testing and (insurance) rating approach for AEB systems. The group mainly consisted of insurance institutes, but was supported by Volvo Car Corporation and Continental. The European Commission sponsored research project ASSESS (Assessment of Integrated Vehicle Safety Systems for improved vehicle safety)[28] and the German initiative led by Dekra, called vFSS (Advanced Forward-Looking Safety Systems)[29] had similar project goals to develop harmonized and standardized assessment procedures and related tools for selected integrated safety systems. The Euro NCAP AEB test and assessment procedures were born out of the deliverables of these projects.[30]

Euro NCAP adopted both low speed and high speed AEB systems in the rating scheme in 2014. Low speed AEB systems, AEB City, where directly linked to whiplash prevention and therefore added to Adult Occupant Protection. High speed AEB systems, AEB Inter-Urban, addressing crashes with more variable outcome in terms of injuries were included in Safety Assist.

The impact of Euro NCAP

Equipment fitment

One of the most overlooked benefits of the consumer rating system in Europe is its impact on availability and fitment of equipment across the EU markets. From the start, Euro NCAP tested the best-selling variant of a model in order to achieve the most relevant rating for the market as a whole. The downside of this approach was that lower specification vehicles were offered in (often Central, East and Southeast) European markets where sales were not expected to be high enough. In 2007, Euro NCAP therefore started to demand that all equipment relevant to the safety rating be fitted as standard or, in exceptional cases, meet a minimum fitment percentage over the whole of EU-28. The latter fitment requirement was ramped up in yearly steps to 100% by 2012, effectively requiring manufacturers to make safety equipment standard across the board from then on.

The fitment policy has been very effective in propagating systems like head curtain airbags (Fig. 3), ISOFIX anchorages, SBR and ESC across the European market. It has become the norm for new cars tested by Euro NCAP to be fitted with such systems, despite the fact that these are/were not mandated by law. Recently, there has also been a rise in the number of mainstream models available with Speed Assistance and AEB and/or FCW systems. That is a welcome sign for road safety and helps pave the way for the eventual deployment of highly automated vehicles.

Engineering improvements

During the first years of testing, much of the engineering effort went into achieving higher scores in the frontal and side impact crash tests. The reduction in passenger compartment intrusion in frontal impact is the most visible effect of Euro NCAP's influence. By preventing intrusion, the likelihood of the occupant impacting the car's interior is minimized, providing space for the restraint system to operate effectively. As a result, injury parameters measured by driver and front passenger dummies came down significantly. Also, some manufacturers have completely cleared the knee impact zones of potential hazards as a result of Euro NCAP's scoring scheme for this area. Similarly, Euro NCAP has seen large structural improvements in side impact performance. The provision of side impact and head airbags has helped and it is now normal for the cars to be fitted with side impact airbags and curtains.

Euro NCAP has encouraged improved designs and the fitment of ISOFIX mounts and child restraints. ISOFIX provides a much more secure method of attaching the child restraint to the car, provided that additional provision is made to prevent rotation of the child restraint, which can be caused by seat cushion compression and rebound. As a consequence, Euro NCAP has seen improved designs, where the child is less likely to strike the car interior whilst at the same time experiencing reduced forces from the restraint system.

One of the most remarkable effects of the introduction of the overall rating has been the improved score in pedestrian subsystem tests since 2009 (Fig. 4). Supported by an extensive review of protocols that has made the engineering goals more attainable and a soft landing approach in the rating calculation, car manufactures have delivered energy absorbing bumpers, deployable bonnets and external airbags and have repositioned stiff structures in order to boost their performance.

Real world crashes and injuries

Although Euro NCAP's ratings have been seen to improve over time, the only real proof of Euro NCAP's effectiveness lies in real-world accident data. Several analyses have been carried out that show the effect of improvements in vehicle safety, many of which have been influenced by Euro NCAP.

In 2000, SNRA and Monash University[31] reported that “cars with three or four adult occupant stars are approximately 30% safer, compared to two star cars or cars without a Euro NCAP score, in car-to-car collisions.” Data was also provided which showed that the predicted relative risk of severe or fatal injury was reduced by 12%, for each increase in Euro NCAP star rating. In 2001, a Monash University report for SARAC[32] reported that the Euro NCAP star rating is able to differentiate with statistical significance both the average crashworthiness and injury severity based on all real crashes of vehicles in star rating categories 1, 2 and 4. Further evidence of the effectiveness of Secondary Safety improvements in the early years of Euro NCAP were reported in the journal *Accident Analysis & Prevention*.

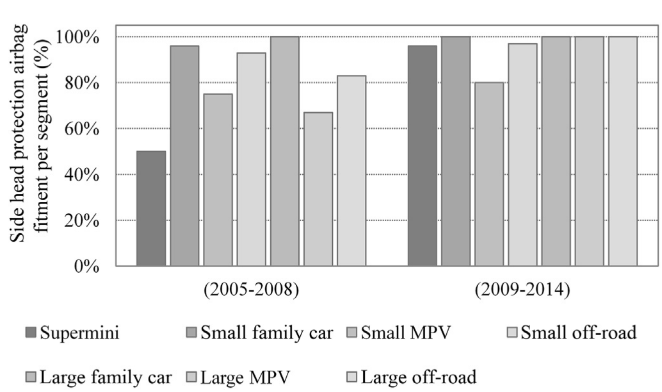

Fig. 3. The share of cars equipped with side head protection airbags increased for all car segments after greater emphasis was laid upon fulfilling pole test requirements in 2009.

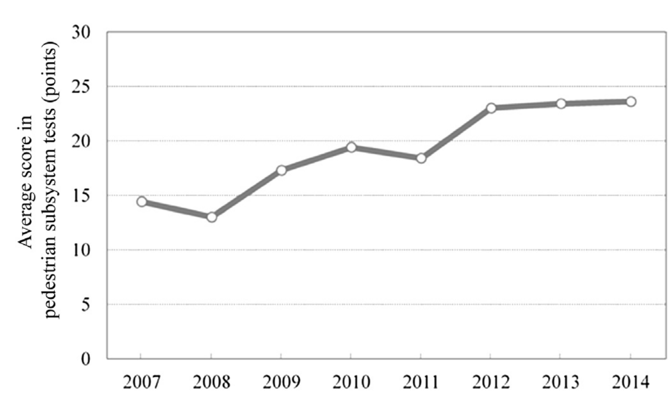

Fig. 4. On average the score achieved in pedestrian subsystems tests increased. According to Pastor, each point relates to a reduction in the probability of 2.5% for fatalities and 1% for serious injuries.

The benefits of Intelligent Seat Belt Reminders have been shown in several reports from Folksam insurance, the Swedish Traffic Administration and others. Lie et al[33] conducted an extensive study into the effect of enhanced SBR. The data were collected by field observations in major cities in six European countries and in five cities around Sweden. A selection of car models having seat belt reminders (SBR) were compared to a fleet of similar car models without such reminders. This study concludes that SBR fulfilling Euro NCAP's SBR protocol significantly increase seat belt use in daily traffic. Around 80% (82.2% ± 8.6%) of drivers not wearing a belt in cars with no seat belt reminder do so in cars equipped with a system that has a light signal and an associated loud and clear sound signal. This finding is in line with earlier studies from Europe and USA that also found that enhanced SBR with light and sound are most effective.[34]

A significant correlation between Euro NCAP pedestrian scores and injury outcome was reported by Pastor[35] using German National Accident Records from 2009 to 2011. Comparing a vehicle scoring 5 points and a vehicle scoring 22 points, pedestrians' conditional probability of getting fatally injured was reduced by 35% (from 0.58% to 0.37%) for the latter. At the same time the probability of serious injuries could be reduced by 16% (from 27.4% to 22.9%). Strandroth et al[36] also showed a significant reduction of injury severity for cars with better pedestrian scoring. In this study, the Euro NCAP pedestrian scoring was compared with the real-life outcome in pedestrian crashes that occurred in Sweden 2003–2010. The real-life crash data was obtained from the data acquisition system STRADA, which combines police records and hospital admission data. The reduction of Risk of Serious Consequences (RSC) for medium performing cars in comparison with low performing cars was 17%, 26% and 38% for 1%, 5% and 10% of medical impairment, respectively. These results applied to urban areas with speed limits up to 50 km/h only.

Kullgren et al[37] carried out an evaluation of the Euro NCAP, Japan NCAP and IIWPG whiplash protocols using real-world crash data. Three analyses were undertaken comprising an analysis of test outcome data, a logistic regression analysis, a receiver operating characteristic (ROC) analysis, and a correlation analysis comparing crash and injury outcome. Correlations between the test scenarios of each of the three protocols, as well as the outcome associations with crash outcomes, suggested consistent improvements in the risk of permanent medical impairment.

Finally, Euro NCAP with support of the Australasian NCAP[38] studied the effectiveness of low speed AEB systems promoted through the rating scheme since 2014. Real-world evaluations of advanced safety systems are often limited by slow take-up rates, insufficient crash data and lower crash rates of new, safer vehicles. To overcome this, data from five European countries plus Australia were pooled using a standard analysis format and a novel prospective meta-analysis approach. The study showed that low speed AEB technology leads to a 38% reduction in real-world rear-end crashes with no significant difference between urban and rural crash benefits being observed. The publication confirmed that Autonomous Emergency Braking is one of the most promising safety technologies in recent years.

Global reach

The increasing globalisation of the car market and the rise of the emerging markets have seen the deployment of new safety rating initiatives in more regions of the world. In 2009, Global NCAP initiated the Latin NCAP for Latin America, soon followed by ASEAN NCAP in Southeast Asia. Both programmes, taking advantage of the technical know-how and procedures of Euro and Australasian NCAP, have quickly gained momentum. The links between Euro NCAP and the new NCAPs, Australasian NCAP and to a lesser extend Japan NCAP, Korean NCAP and China NCAP, have increased Euro NCAP's scope and are partly responsible for its evolution from a safety rating for the European market to a “benchmark” standard for global vehicle development.

A view into the future of automotive safety

Challenges ahead

New cars today are much safer than they were a decade ago thanks to improved crash test standards, crumple zones, seat belts and airbags, which help to protect occupants in a crash. While most occupant safety measures can be considered mature, more could and should be done to improve their robustness and effectiveness for the general diversity of vehicle occupants and crash scenarios. This is particularly true for an aging driving population.

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 is 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 on-board 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.

Roadmap

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 has 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.

In 2014, Euro NCAP published a roadmap[39] for further developments of the safety rating in the next 5 years. The plan identifies four main domains that focus on the key real life crash scenarios and that can be addressed by new and updated vehicle technology, in particular in the field of crash avoidance. This includes, amongst others, the addition of AEB technology for vulnerable road users (pedestrians and cyclists) and the testing of more capable driver support systems for longitudinal and lateral car crashes.

Concluding remarks

Most consumers will have no personal experience on which to judge the crash safety of their car. Are they happy with the level of safety offered? Can they specify what level they want? Can they assess whether this objective has been met? Clearly, without objective and transparent safety information, these questions would be impossible to answer. This underlines the importance of public safety ratings and justifies why Euro NCAP continues to develop its comparative safety tests. Moreover, it explains why Euro NCAP's online and written publications continue to grow in popularity, not only with consumers but also more and more with public and private fleet managers to help them ensure that the safety of their vehicle fleet provides acceptable levels of protection to their employees.

At the time of launch of the first Euro NCAP results in February 1997, some critics claimed that the assessment criteria were so severe that no car could ever achieve (the then maximum) four stars for occupant protection. In July 1997 results from the second phase of tests were published and included the first 4 star results, for the Volvo S40. This illustrates two important insights that have proven to be true time after time over the last two decades. Firstly, given clear, objective targets and "sufficient" time, the car manufacturers can make great safety improvements. Secondly, "sufficient" time does not always have to mean years, as many manufacturers have responded very quickly to new challenges in the past. A consumer rating system, like Euro NCAP, that is rooted firmly on real life experiences but which closely follows the technological innovations in the marketplace can therefore deliver the most benefit for society.

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