IMPROVEMENTS TO ASEAN NCAP CRASH TEST RATING SANS A PLATFORM CHANGE

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ABSTRACT

Besides other reasons, car manufacturers often develop new cars with the aim to improve on their ASEAN NCAP crash safety performance rating. Apart from car safety assist, such ratings depend on the degree of adult occupant protection (AOP) and child occupant protection (COP) measured via the seriousness of injuries to dummies. This study shall explain how car manufacturers can improve their crash performance rating without changing the platform structure of a new car. The move shall be more cost effective as platform structure development is expensive; and less time consuming to enable a product to be launched in time (Al-zaher & Elmaraghy, 2014; Al-zaher & Elmaraghy, 2014). Two ASEAN NCAP crash tests have been conducted on 2 car brands on two different occasions, with the more recent result showing improvement from 3-Star to 4-Star rating. This proves that without a platform structure change, a high rating can still be achieved. Such a situation will help manufacturers save cost and reduce time to develop a new car by using the same platform structure but with better safety performance.

INTRODUCTION

An important element of any car is the body structure or platform [1]. The platform connects all the different components; whereby it houses the drive train and more importantly carries and protects passengers and cargo. The body structure needs to be rigid to support weight and stress and to securely tie all the components [2]. Furthermore, it must resist and soften the impact of a crash to safely protect the occupants. Thus, most automobile manufacturers seek to design better automobile structure to ensure passenger safety as well as reduce the automobile mass [3].

ASEAN NCAP Safety Star Rating *vis-a-vis* or pertaining to a car body structure focuses more on passive safety whereby tests are carried out to assess frontal and side impacts. Nonetheless, the regulations in regard to these assessments have become more stringent in the past decade. Many automobile industries are therefore aiming to design better platform structure for passenger safety as well as to reduce platform mass [4]. Better platform structure will hopefully enhance passive safety and a good body structure base will possibly result in better crash performance. It is important to note that a good crash performance is achieved by way of impact energy absorption [2]. In other words, how impact energy is absorbed will affect the severity of passenger physical injuries as well as damage to the car interior [5]. The less injury a passenger dummy suffers, the higher the structure performance is rated.

All passenger cars are built on platforms or architectures defining the core engineering of a vehicle. Traditionally, automotive OEMs have shared this engineering across products. For example, under the hood, Skoda Fabia and Volkswagen Polo use the same engineering structure. As platform development accounts for nearly half of the product development cost borne by Original Equipment Manufacturers (OEMs), the strategy of using common engineering across vehicle models have enabled them to cut cost as well as save time [6]. If the industry can create one good platform to enhance crash performance and use this method of sharing, there will be an increase of safer cars on the market and more lives can be saved as a consequence of a reduced passenger injury. This paper shall highlight that with some enhancements made to new car *sans* or without a platform change, it is possible to improve their ASEAN NCAP rating from 3-Star to 4-Star.

PLATFORM STRUCTURE

A vehicle frame, which is also called chassis, is the main supporting structure of a motor vehicle to which all other components are attached. Most car models and even car types share a set of common design, engineering, production efforts, as well as major components [7]. This practice is a norm in the automotive industry to reduce the cost associated with product development by basing several products on a smaller number of platforms [8]. This further allows companies to create distinct models from a similar design perspective.

As mentioned earlier, ASEAN NCAP Star Rating for platform structure is conducted via the frontal crash and side impact barrier crash tests. The detail calculation is based on (i) injuries suffered by a dummy's head, chest, knees, tibia, and foot during a crash test and (ii) the car body structure (also known as modifiers). For the frontal impact against offset deformable barrier (ODB) with 40 % overlap at 64 km/h, the structure rating will divided into two parts, namely the upper occupant compartment and lower occupant compartment. In addition, for side impact mobile deformable barrier (MDB) at 50 km/h, scores will only be calculated for rating purposes.

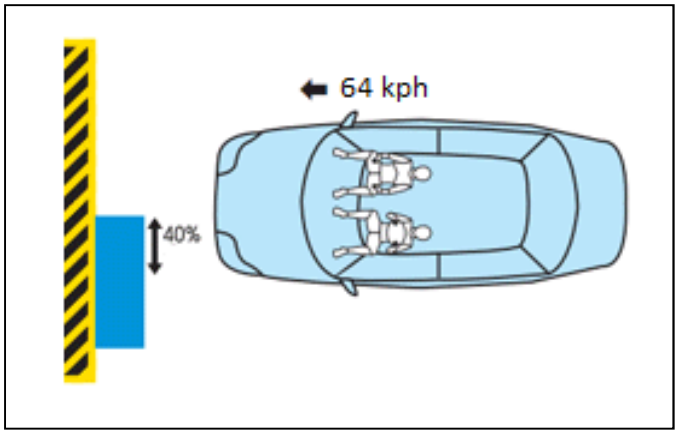


Figure 1. Example of frontal impact 40% ODB

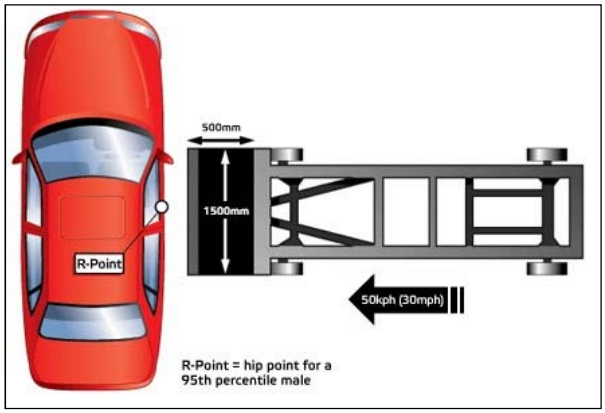
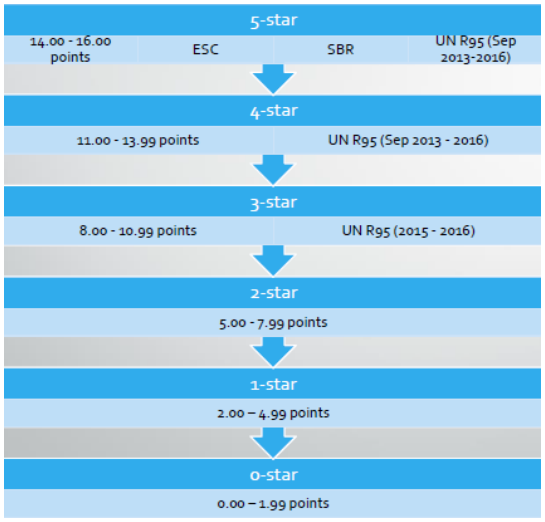
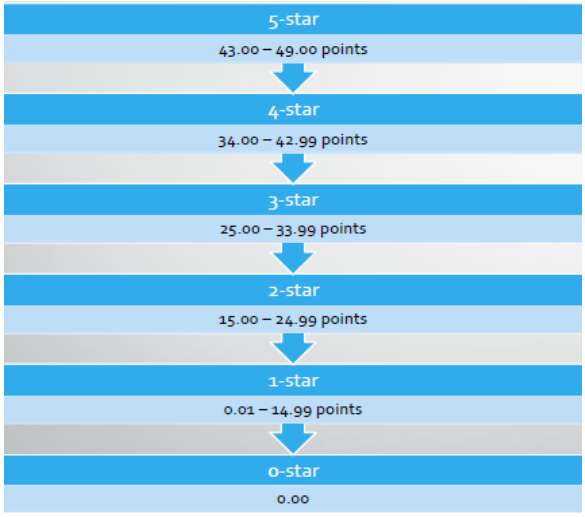


Figure 2. Example of side impact MDB

CASE STUDY

ASEAN NCAP rating calculation is divided into three categories, which are AOP, COP and safety assist. Each category has different calculations and will affect the overall Star Rating [9]. Table 1 below shows AOP rating and COP rating from 5-Star to 0-Star based on ASEAN NCAP protocol 2012-2016.

Table 1.
Rating protocol based on protocol 2012-2016

Adult occupant protection (AOP) Rating	Child occupant protection (COP) Rating
	

The entire Star Rating is based on the frontal crash and side impact crash tests. Both crashes use P1.5 and P3 dummies to represent children and hybrid III 50% dummies for adults. In the frontal crash, a car will impact the 40% OBD (Offset-Deformable Barrier) at a travelling speed of 64 km/h. As for the side impact test, a car occupied by ES-2 dummy will be impacted with MDB EEVC (Mobile deformable barrier European Enhanced Vehicle-safety committee) (900kg) at a travelling speed of 50km/h. For AOP assessment, results of the frontal crash impact will be calculated in terms of the injury suffered by the dummies and the car structure modifier. Figure 3 shows the division of points for AOP dummy injury. Further, COP also looks at inclusion of CRS (child restrain seat), as well as vehicle-based test and dynamic test to obtain the highest score of 49.00 points.

This testifies that the main contributor to the points in determining ASEAN NCAP Star Rating is the injury to the dummies. The less the injury to the dummies, the higher Star Rating shall be awarded. Further, crash test impact is conducted to determine the level of strength and impact energy absorption of a vehicle [10]. In order to reduce injury of the dummies upon impact, automotive manufacturers need to improve passive safety technology which shall in turn elevate their ASEAN NCAP rating. To enhance passive safety capability, it is not necessary to change the platform structure because in the past, ASEAN NCAP has seen two car brands which had successfully upgraded their rating without changing their original platform structure [11]. Such a feat was achieved by adding strength to the platform structure and upgrading some components in both cars.

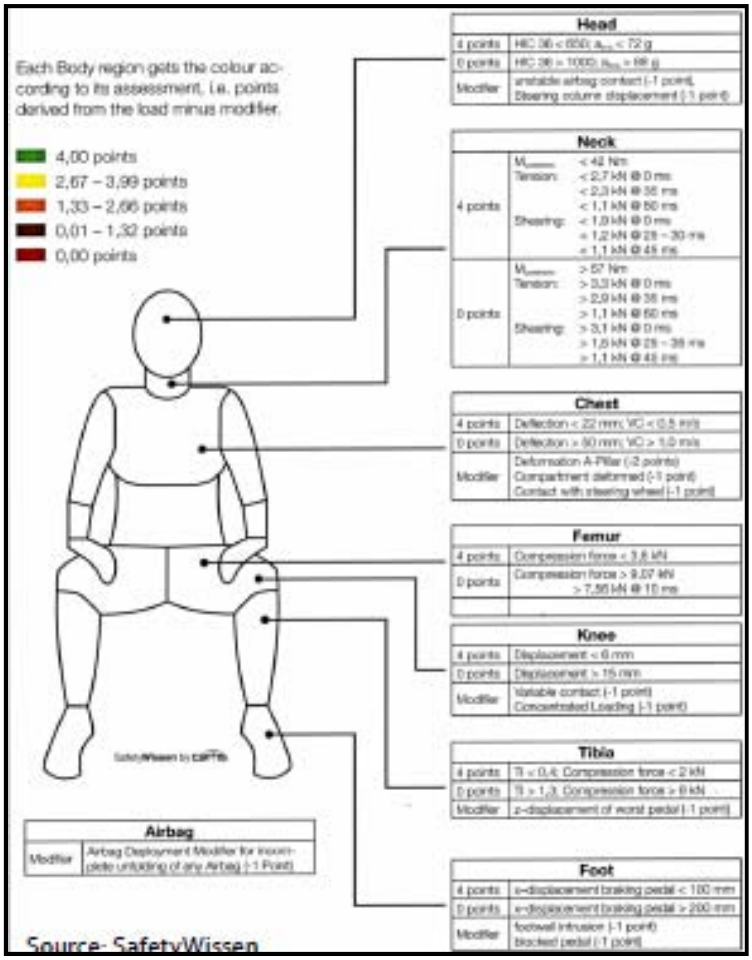


Figure 3. Example AOP Calculation Point

HISTORY OF ASEAN NCAP RATING UPGRADE

Vehicle brand 1

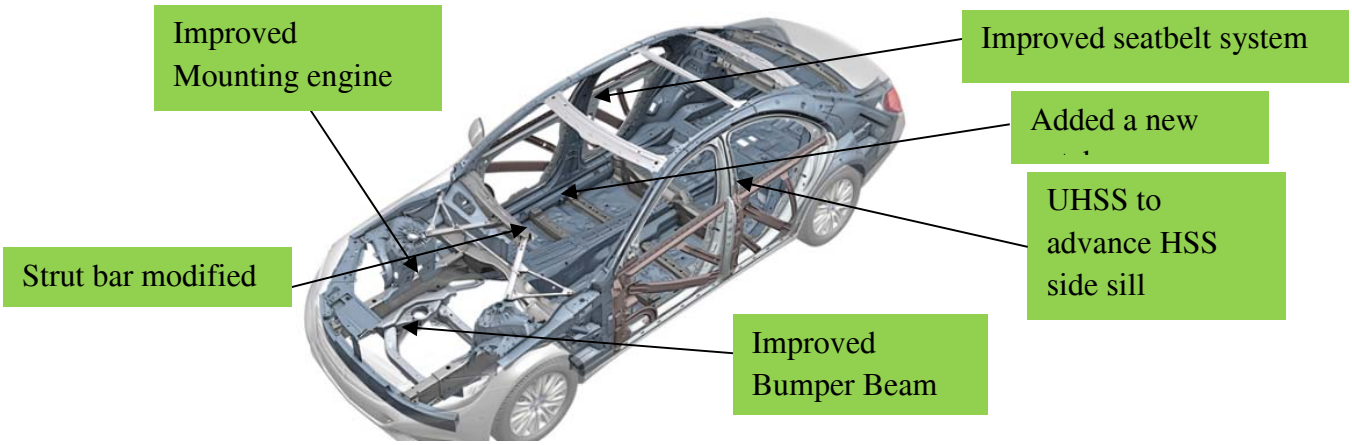
As per its background, Vehicle 1 is categorized as a 4-door sedan of the same variant and platform but with different engine capacity and kerb mass. In order for the manufacturer to use the platform for a new car but with better safety, some upgrading works had to be done. The result of the first crash test was 3-Star, but following some upgrading to the body structure, the rating improved to 4-Star upon being re-crashed. The gap between both crash tests was 3 years. The upgrading carried out is as shown below:

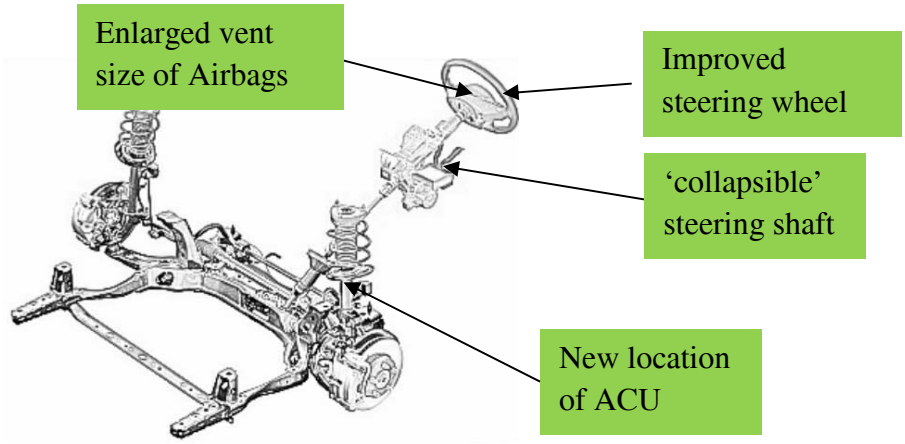
<u>Body structure improvements</u>

- Improved Bumper beam area
- Improved Mounting engine
- At driver and passenger area of leg to knee - changed from UHSS to advance HSS side sill
- Strut bar added
- Improved seatbelt system
- Adding of patch car floor

<u>Component structure system upgrading</u>

- Improved the ‘collapsible’ steering shaft
- Upgraded steering wheel
- Enlarged size of vent DAB and PAB
- ACU position changed to more strategic location





The first crash test was in 2013, and following a lot of changes and upgrading, the second crash test for Vehicle 1 registered an improvement in terms of its safety features where it achieved 13.33 over 16.00 points in the AOP, thus placing it in the 4-Star category. Compared to the previous test, Vehicle 1 was awarded 10.23 points with 3-Star rating for its AOP.

As for the COP, Vehicle 1 recorded a commendable achievement by obtaining 71% compliance, which was within 4-Star rating. Vehicle 1 comes with standard dual airbags and Seatbelt Reminder System (SBR) for driver only. Furthermore, Vehicle 1 is equipped with standard ISOFIX and top tether. However, Anti-lock Braking System (ABS) is not available in all variants while Electronic Stability Control (ESC) can only be found in the premium variant.

Vehicle brand 2

As per the background, Vehicle 2 is categorized as a 5-door hatchback of the same variant with the same platform and engine capacity but different kerb mass. In order for the manufacturer to use the same platform structure for a new car with better safety, some upgrading works had to be done. In the first crash test, Vehicle 2 was awarded 3-Star, but upon improvements to the body structure, it was awarded 4-Star after being re-crashed. The gap between the first and second crash tests was 2 years. The upgrading carried out is as shown below:

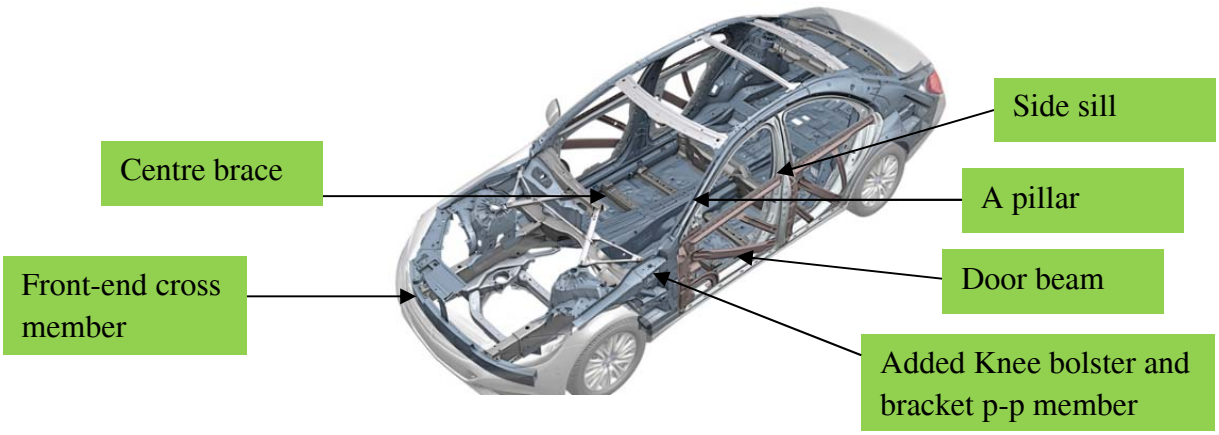
Body structure (improved to prevent cabin and body deformation)

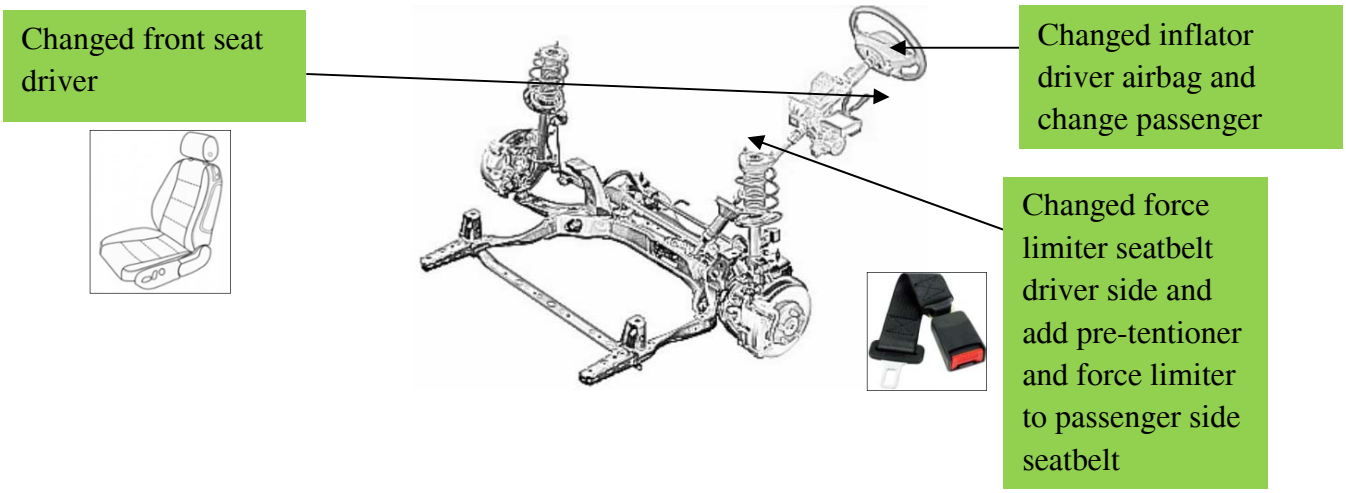
- Door beam
- A pillar
- Side sills
- Centre brace

- Front-end cross member

Passenger restraint

- Improved quality of airbag
- Improved material of seatbelt
- Additional Knee bolster
- Additional bracket P-P member
- Changed front seat driver
- Changed inflator driver airbag
- Changed passenger airbag





Upon making some changes to the body structure and passenger restraint, Vehicle 2 latest version (crash tested in 2015) obtained 4-Star in AOP with 11.55 points. In comparison, it was awarded 3-Star AOP with 8.71 points in 2013. Vehicle 2, which is the all time best selling model in Malaysia has also improved its score in COP with 71 % compared to 54% in the first crash test. It is therefore rated 4-Star. As per the child restraint system, ISOFIX & top tether are available as standard fitment. The stability control system (ESC) is, nevertheless, only offered in higher variants.

CONCLUSION

Car manufacturers have always competed by coming up with newer cars in a bid to become the market leader. Of late, with the launch of each new model, they will make sure that aside from the aesthetic features and fuel efficiency, the safety aspects will also be taken into account. Such safety aspects are translated into high Star Rating awarded by NCAPs across the globe. At the same time, car makers must also find the most viable solution to come up with competitive products at lower costs and increased profits [12]. This study has

elucidated that in order to improve crash safety performance, a manufacturer does not necessarily need to change the platform structure for a new car. ASEAN NCAP's crash test results involving Vehicle brand 1 and Vehicle brand 2 provided a clear example that a car safety performance rating can be improved without changing the platform structure. What was needed were merely several changes to the passenger restraint system, component system as well as the body structure. Furthermore, better crash performance is indicated by lower injury levels to passenger which in return raises interest among potential car buyers. Collaboration between brands to share the platform structure with good crash performance result could, at the same time, reduce the cost of producing safer new cars. But more importantly, such a practice will ensure more safer cars on the market and thereby result in safer roads.

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