DEVELOPING A CONSUMER SAFETY RATING FOR VANS

Colin Grover,
Matthew Avery
Thatcham Research
UK

Iain Knight,
Apollo Vehicle Safety
UK
Paper Number 23-0298

ABSTRACT

Home delivery is one of many trends driving a strong increase in the use of light commercial vehicles (≤ 3,500kg GVW, aka vans). In Europe, vans have for many years been subject to less stringent safety regulations than passenger cars and had fewer safety systems fitted. The research objective was, therefore, to assess the safety risks posed by the increasing use of vans and to develop a programme of consumer testing to promote relevant risk mitigations. The work involved a wide range of Euro NCAP Member organisations under the umbrella of the Commercial Vehicle Working Group, chaired by Thatcham Research, and subsequent evolution under its own unique working group chaired by CSI.

The work programme undertaken by the group included:

- Collision data analysis
- Market research to assess ADAS fitment
- Full scale collision test
- Track testing of ADAS solutions

Across 5 Euro NCAP member countries vans were involved in around 8% of road fatalities. The types of collisions they were involved in, the causes and consequences were similar to those of passenger cars. The most common collision opponent was other passenger cars, but the fatalities were not evenly distributed between each vehicle. In collisions involving vans, a larger proportion of the total fatalities occurred in the car than in the van.

A full-scale vehicle to vehicle crash test was undertaken between a van and a 5-star car. The van exhibited limitations in terms of both self-protection and compatibility. Both van occupants showed a high risk of injury to the chest, knee, femur and pelvis. The good design of the passenger car helped limit the consequences for its occupants, but they still showed significantly higher risk of injury than in the equivalent barrier test.

Market research showed that the availability of ADAS was low, almost always optional and, even when available, was poorly understood by dealers making it hard to actually get hold of vehicles. Tests of the ADAS showed that they could be effective but, in some cases, offered significantly lower performance than similar systems on passenger cars from the same manufacturer.

A new van rating scheme was developed, based on adaptation of existing passenger car protocols for ADAS but not for full scale crash. Ratings of the whole market in the EU have been undertaken in 2021 and 2022 and the scores have improved substantially.

INTRODUCTION

In its roadmap to 2025 [1] Euro NCAP announced its intention to support the development of a truck city safety label. In 2020 the Commercial Vehicle working group was created and began by developing assessments of the ADAS offered on light commercial vehicles <3,500kg as part of developments building toward a rating for heavier trucks.

Home delivery is one of many trends driving a strong increase in the use of light commercial vehicles (≤ 3,500kg GVW, aka vans). In Europe, vans have for many years been subject to less stringent safety regulations than passenger cars and had fewer safety systems fitted. The research objective was, therefore to assess the safety risks posed by the increasing use of vans and to develop a programme of consumer testing to promote relevant risk mitigations. The work involved a wide range of Euro NCAP Member organisations under the umbrella of the Commercial Vehicle Working Group, chaired by Thatcham Research, and subsequent evolution under its own unique working group chaired by CSI.

The work has involved considerable studies of market and collision data to understand the nature of the problems that need to be solved for vans, a crash test to demonstrate the effects of the larger vehicles and the development of safety protocols and a rating scheme designed to solve the problems identified.

QUANTIFYING THE PROBLEM

Exposure to risk

It is undeniable that the number of vans on the roads has increased over time. For example, in GB in 2021 there were nearly 4.5 million vans on the roads, representing 11% of all vehicles, compared with a little more than 2 million in 1994, representing just 8% of all vehicles. This trend has been repeated in countries across Europe.

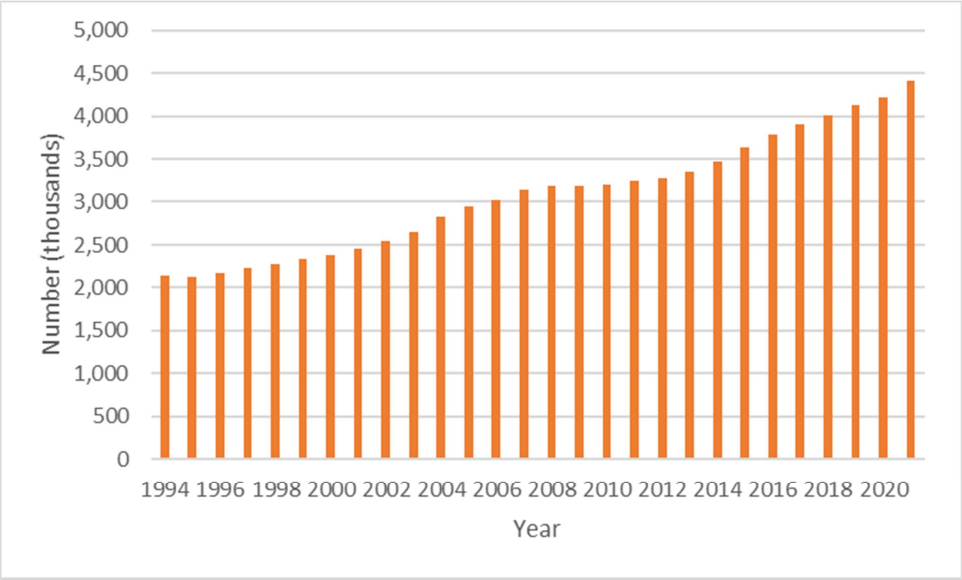
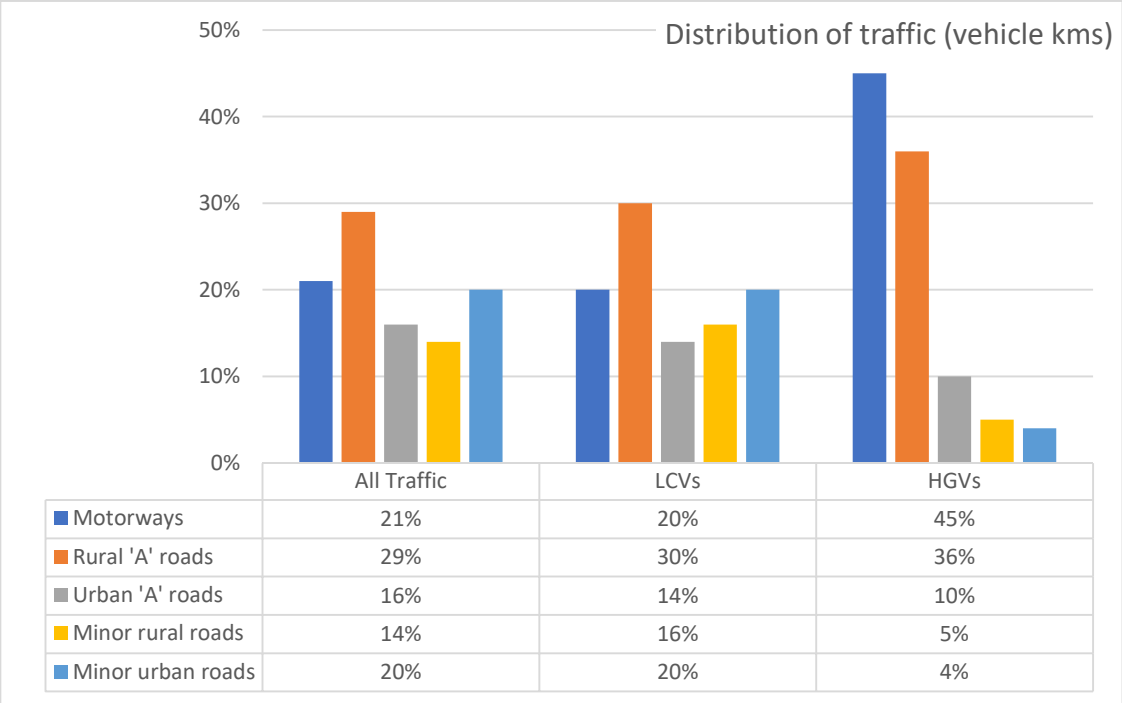


Figure 1: Number of vans registered at the end of each year in GB. Source: DfT licensing statistics

Home delivery is often cited as the factor driving an increase in the use of vans. This is of course a very significant factor but the evidence [2] suggests that growth in van traffic has been and will continue to be driven by multiple complex economic, logistic and supply chain factors, not just home deliveries. These factors include outsourcing of technical services to specialist companies (e.g. mobile repair services), an increase in the length and height of vans, and a shift from heavier goods vehicles to lighter, for many reasons such as an increase in just in time deliveries with smaller consignment sizes, reduced regulatory burdens and total cost of ownership and an increased supply of drivers because there is no need for a special license. In addition to this, trends to relocate industrial sites, centralised stockholding, reduced use of local suppliers have all tended to increase the annual average distance travelled by vans. All of these factors tend to increase their exposure to road risk.

It is well documented that heavier goods vehicles spend a larger proportion of their driving distance on major roads such as motorways when compared with traffic as a whole. In line with the home delivery theory above, it may be expected that vans would be used primarily in urban areas. However, the data (**Figure 2**) shows this is

not the case and, in actual fact, the usage of vans is very similarly distributed to ‘all traffic’, which is dominated by passenger cars.



	All Traffic	LCVs	HGVs
Motorways	21%	20%	45%
Rural 'A' roads	29%	30%	36%
Urban 'A' roads	16%	14%	10%
Minor rural roads	14%	16%	5%
Minor urban roads	20%	20%	4%

Figure 2: Distribution of traffic by road type in UK. Source: DfT traffic statistics

So, the exposure to risk of vans will be high in relation to the number of vans (higher average distances), low but growing in comparison to that of passenger cars and distributed very similarly to passenger cars in terms of locations and road types. It seems that vans are considered ‘go anywhere’ types of vehicles, similar to cars but unlike heavier goods vehicles that often target a particular freight task.

Collisions & Casualties

Euro NCAP Members have produced an analysis of the number and type of road users killed in collisions involving two vehicles or less that occurred between 2017 and 2019, involving a range of different types of vehicles. Five countries are represented (France, Great Britain, Germany, Italy and Sweden). In total over the combined three-year period, this data provided information on 28,452 fatalities from all types of collisions and 2,307 fatalities from collisions involving at least one van. The people killed in these collisions were as shown in **Figure 3**, below.

It can be seen that the single largest group of fatalities in collisions involving vans are car occupants. When considering that van occupants will also be killed in crashes with other vehicle, then it is clear that when a car hits a van, it is more likely that the car occupant will be killed than the van occupant. In fact, the Euro NCAP data showed that only 14% of the van occupant fatalities (4% of all fatalities) occurred in collision with a car. Whereas by definition of the sample, all of the 35% of fatalities that were car occupants would have been killed in collisions with a van. So in fact, in collisions between cars and vans, the outcome is clearly much worse for the car occupant. Van occupants are most commonly killed in single vehicle collisions (42% of van fatalities, 13% of all fatalities) and collisions with other vans or heavier vehicles such as trucks and buses (collectively 42% of van fatalities or 13% of all fatalities).

This is broadly consistent with other studies on the same subject [3]. In these studies, it was noted that seat belt use was much lower than for passenger cars but that otherwise the distribution of crashes represented a significant difficulty for crashworthiness improvements. Improving frontal structures to better protect van occupants in collision with roadside furniture or in collision with other vans, trucks and buses could lead to increased mass, reduced payload and a further increase in van use. It could also lead to stiffer structures at greater heights from the ground. These latter changes would likely be more hostile to passenger car occupants, who are already more frequently killed than van occupants.

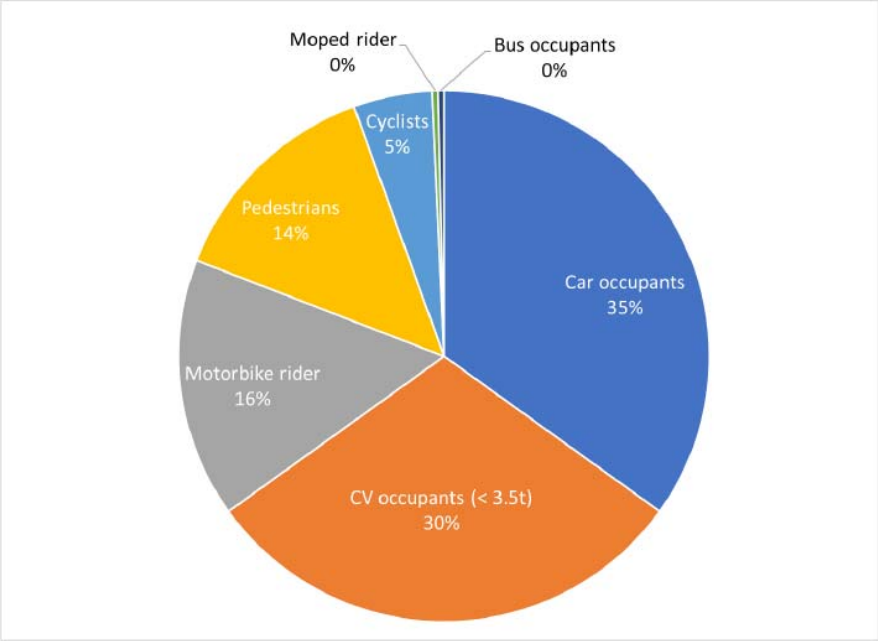


Figure 3: Road user type killed in collisions involving vans (<3.5t). Source Euro NCAP member analysis

HOW DO VEHICLES CURRENTLY PERFORM

The research started with a short programme of crash tests, firstly a van to a passenger car moving vehicle to moving vehicle test, intended to be representative of the Euro NCAP Moving Progressive Deformable Barrier Test but with the real vehicle replacing the MPDB. Secondly, the MPDB procedure was followed completely with the same model of van and the barrier. The results are summarised below

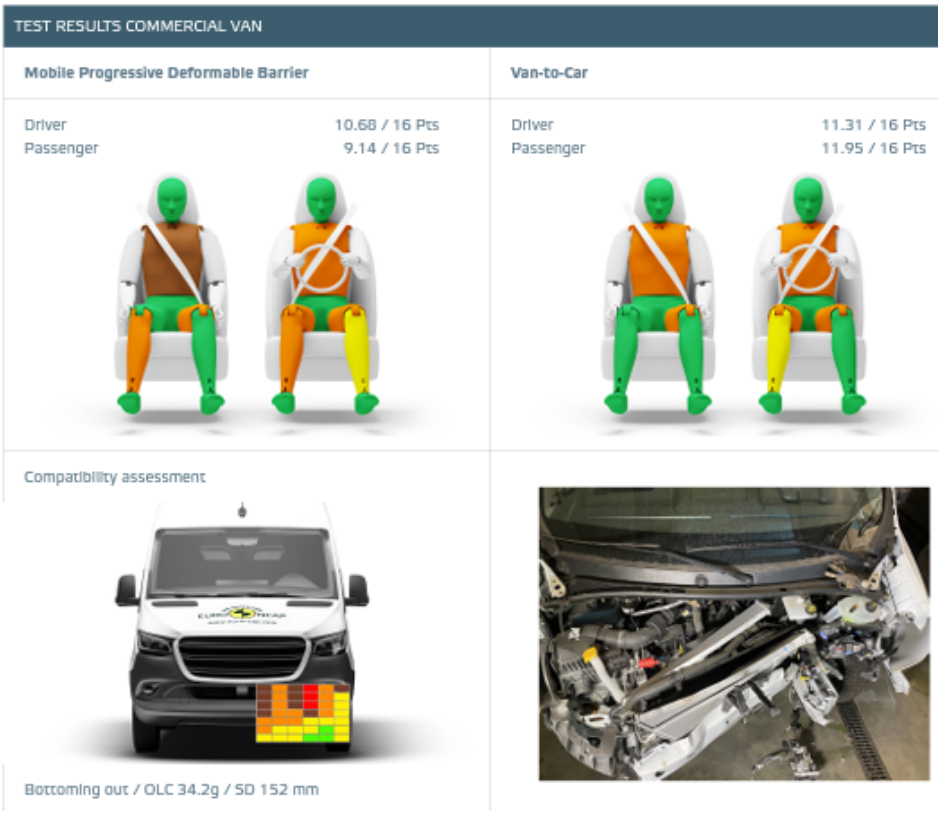


Figure 4: Results of van crash test

With its much greater weight, the van clearly dominated the crash and the MPDB results confirmed the statistical concerns about the crash compatibility with smaller vehicles. Concerns were also noted in relation to a lack of airbag, seatbelt load limiter and pre-tensioner for the passenger in the van and high intrusion and deformation led to a higher risk of injury to the driver chest, knee, femur and pelvis.

The vehicles used in the above tests were the 2019 Nissan Juke (a 5-star car in Euro NCAPs assessment) and the 2019 Nissan NV400 van. The safety equipment fitment of each vehicle was also compared with the results shown in **Figure 5**, below.

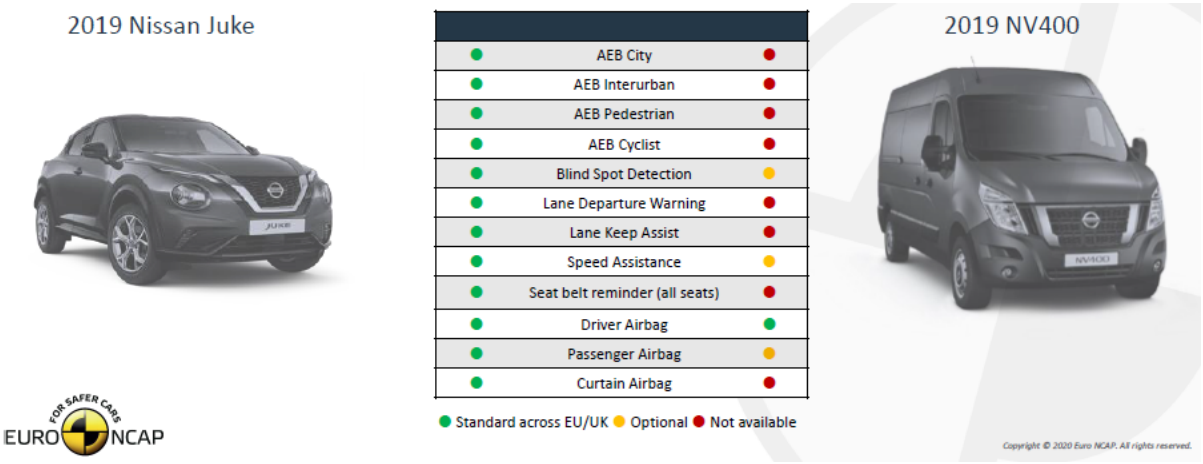


Figure 5: Safety equipment fitment, Nissan Juke and NV 400 van

Although this was considered a relatively extreme example, it graphically highlighted the difference in standards that could exist between cars and vans.

DEVELOPMENT OF THE TEST PROTOCOLS AND RATING SCHEME

It was considered that the best approach to the development of the van scheme was to start relatively simply. As such, the complexity of the self protection and crash compatibility issue for vans, the intention was to focus initially on ADAS, in particular:

- AEB Car 2 car & VRU, excluding night time testing
- Lane support systems (LDW, LKA, ELK, BLIS)
- Speed assistance (MSA, SLIF, ISA)
- Seat Belt reminders (SBR)

Initial exploratory testing and consultation made it clear that the commercial vehicle market, with much lower sales than passenger cars, would always be likely to get the ADAS only once it had already been implemented on passenger cars. In most cases it would not be economic to generate new, higher performing systems first for vans. As such, the decision was taken that the 2021 test programme would use the equivalent 2018 Safety Assist protocols as a starting point.

In most cases, the changes in protocol required to adapt to vans were not great. The collision patterns and scenarios were very similar to cars, the usage of vehicles was similar to cars and the driving dynamics were not greatly different either. However, the influence of load was one area given special consideration.

The payload capacity of loads is much greater than for passenger cars and the centre of mass can also be substantially higher. However, loading the vehicles adds significant preparation time and requires good load security measures to ensure test safety. Vans also may travel lightly laden for a relatively large proportion of their distance because they may be used to carry bulky items rather than heavy items or because they carry tools and materials for other work rather than looking to transport goods at maximum efficiency.

One of the main concerns was the effect on AEB, through changes to pitch angle affecting sensor alignment, increasing the time taken to reach maximum deceleration and/or limiting the maximum deceleration that could be achieved.

Comparative testing at light (test driver plus equipment) and full loads in AEB tests in general found that load had only a very small influence on deceleration profiles.

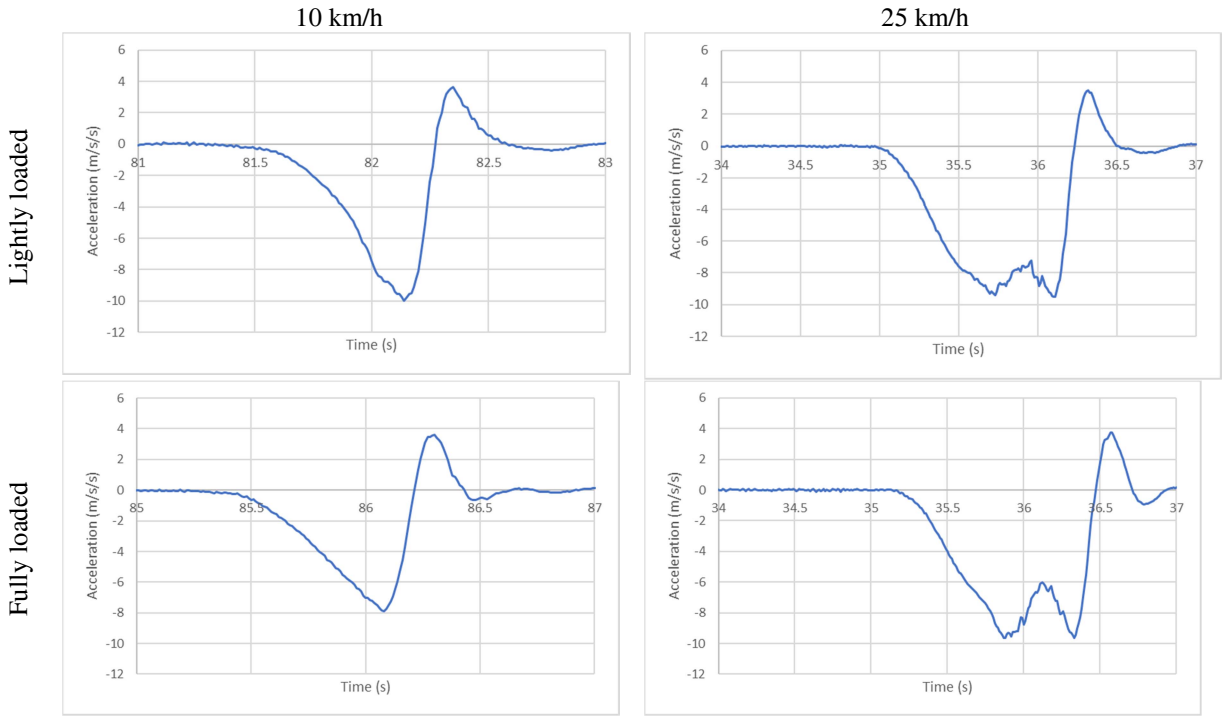


Figure 6: Example deceleration profiles during AEB activation in tests at 10 km/h and 25 km/h, lightly and fully loaded.

Although the effect in 10 km/h tests is noticeable with a slower risk and lower peak, both tests resulted in avoidance. At higher speeds both rise time and peak decelerations were quite similar.

Data was sought on the loading of vans. Although this information is routinely collected in representative surveys in all EU countries for heavy goods vehicles, it is not systematically recorded for vans. Data relating to 2003-2005 from a specific extension to the HGV study in the UK [4] suggests it is relatively rare for vans to be more than 75% of full load.

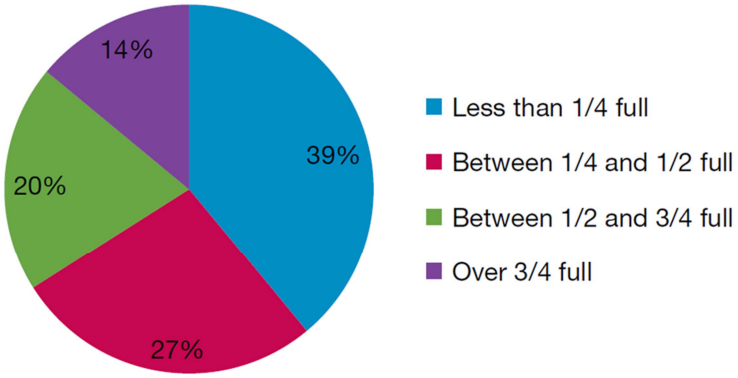


Figure 7: Proportion of van journeys at different states of load. Source: DfT survey data for 2003-2005, as cited by [4]

The results suggest that while there is potential for load to be a significant influence, in practice it appears to be limited. As a result, a decision was taken to test in one load condition, representing 50% of the max payload mass, with the centre of gravity positioned centrally within the load space (or 0.6m above the load bed if a flat bed variant was tested).

RATING OF THE MARKET & RESPONSE FROM INDUSTRY

As show in **Figure 8**, below, there are a relatively small number of makes and models within the van market, and the top 5 selling models represent almost half of all EU sales. In addition to that, eight of the models listed are in fact re-badged variants of another make/model. In combination, this meant that Euro NCAP was able to test models covering 98% of EU sales.

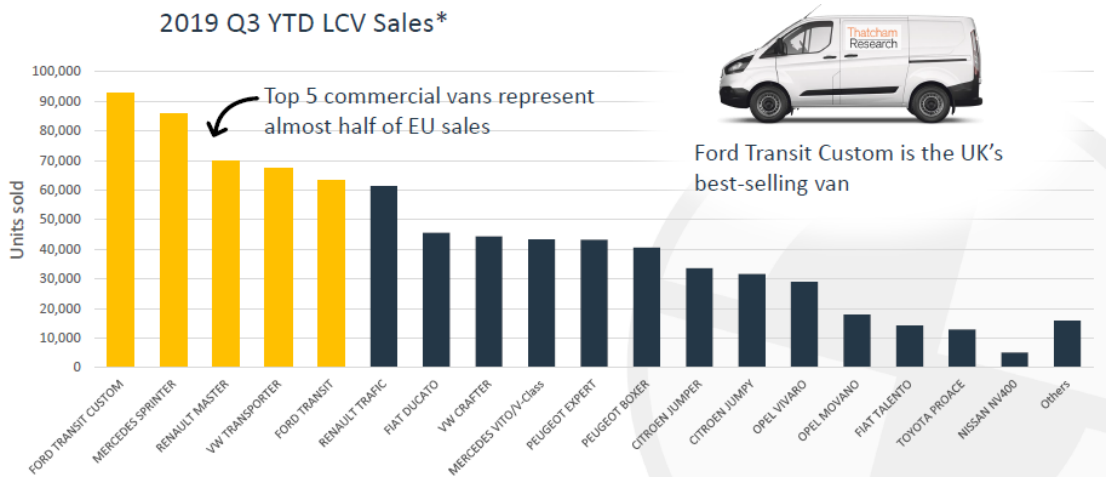


Figure 8: EU van sales by make and model.

The strategy adopted was different to what we use in the car market. So few vehicles were identified that had large quantities of standard fit safety equipment that it was decided to test the best equipped variant available (including specifying optional equipment), rather than the best selling variant with standard equipment.

The relatively straightforward coverage of 98% of the market has meant that Euro NCAP has been able to completely test nearly the whole van market twice, once for the rating published in 2021 and again for one published in 2022. The results are summarised back-to-back in **Figure 9**, below.

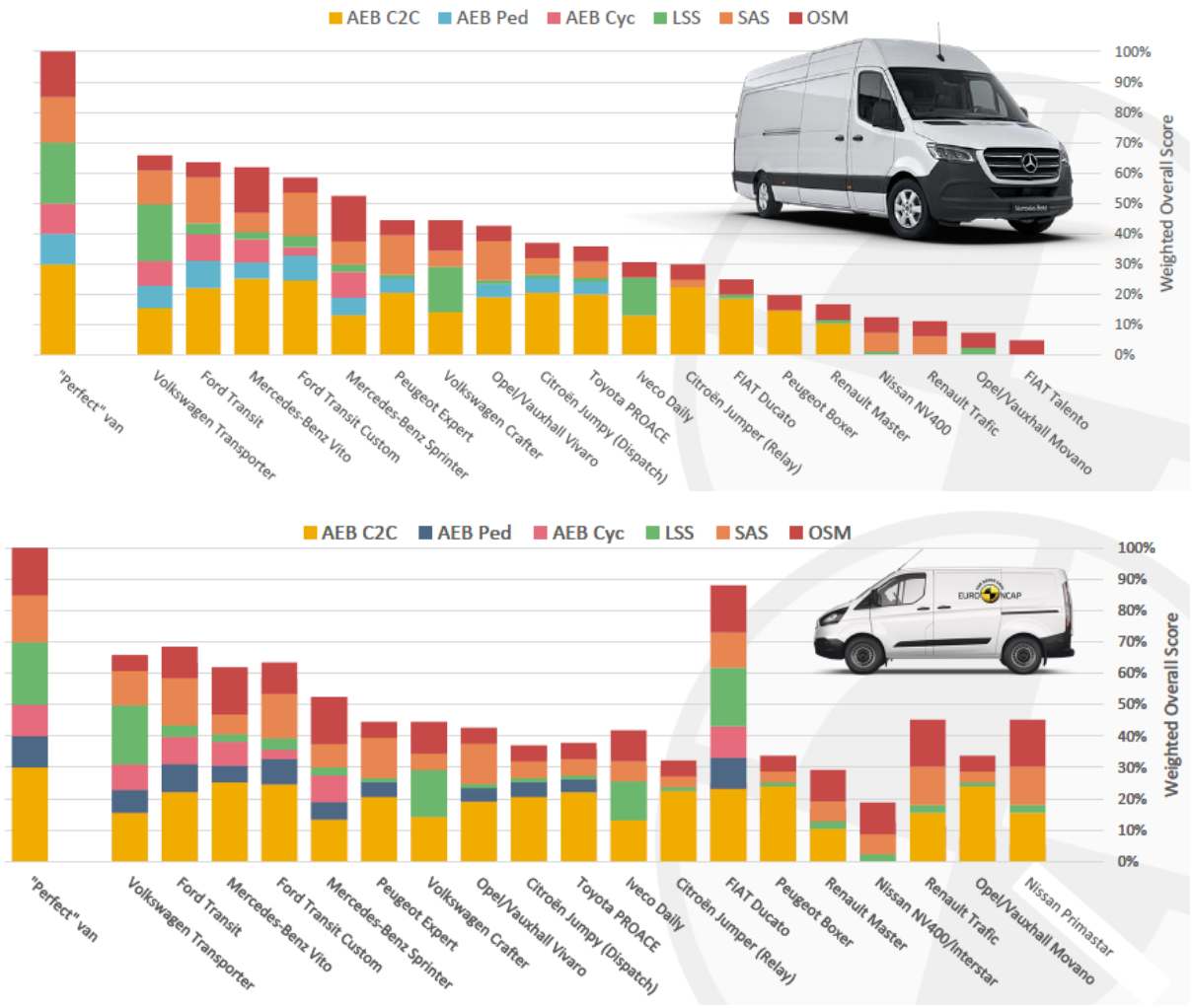


Figure 9: Overall weighted scores for 2021 (top) and 2022 (bottom)

It can be seen that many of the models, particularly those with lower scores in 2021, have substantially improved in 2022.

A comprehensive study of the fitment of key ADAS features was also undertaken and example results for the UK in 2020 are shown in **Figure 10**, below. It was found that there was significant variation across different European countries but in general the quantity of standard fitment in several key safety features was low.

Make & Model (N1*)	AEB C2C	AEB Ped	AEB Cyc	LSS	SAS	OSM
Citroen Jumper (Relay)	○	✗	✗	○	●	●
Citroen Jumpy (Dispatch)	○	○	✗	○	●	●
FIAT Ducato	○	✗	✗	○	○	●
FIAT Talento	✗	✗	✗	✗	✗	●
Ford Transit 2T	○	○	○	○	○	●
Ford Transit Custom	○	○	○	○	○	●
Iveco Daily	○	✗	✗	○	○	●
Mercedes-Benz Sprinter	●	●	●	●	●	●
Mercedes-Benz Vito	●	●	●	○	●	●
Nissan NV400	✗	✗	✗	○	●	●
Opel Movano	✗	✗	✗	○	○	●
Opel Vivaro	○	○	✗	○	●	●
Peugeot Boxer	○	✗	✗	○	●	●
Peugeot Expert	○	○	✗	○	●	●
Renault Master	○	✗	✗	○	○	●
Renault Trafic	✗	✗	✗	✗	○	●
Toyota ProAce	●	●	✗	○	○	●
Volkswagen Crafter	●	✗	✗	○	●	●
Volkswagen Transporter T6.1	●	●	●	○	●	●

Make & Model (N1*)	AEB C2C	AEB Ped	AEB Cyc	LSS	SAS	OSM
Citroën Jumper (Relay)	○	✗	✗	○	●	●
Citroën Jumpy (Dispatch)	○	○	✗	○	●	●
FIAT Ducato	○	○	○	○	○	●
Ford Transit	○	○	○	○	○	●
Ford Transit Custom	○	○	○	○	○	●
Iveco Daily	○	✗	✗	○	○	●
Mercedes-Benz Sprinter	●	●	●	○	●	●
Mercedes-Benz Vito	●	●	●	○	○	●
Nissan Interstar	✗	✗	✗	○	○	●
Nissan Primastar	○	✗	✗	○	○	●
Opel/Vauxhall Movano	○	✗	✗	○	●	●
Opel/Vauxhall Vivaro	○	○	✗	○	●	●
Peugeot Boxer	○	✗	✗	○	●	●
Peugeot Expert	○	○	✗	○	●	●
Renault Master	○	✗	✗	○	○	●
Renault Trafic	○	✗	✗	○	●	●
Toyota PROACE	○	○	✗	✗	●	●
Volkswagen Crafter	●	✗	✗	○	○	●
Volkswagen Transporter	●	●	●	○	●	●

Figure 10: Fitment of safety systems in UK in 2021 (left) and 2022 (right). Solid green – standard, green circle – optional, red cross – not available[1]

Clearly, there has also been improvements in the availability of the safety systems that contribute to the scores, but standard fitment remains low and in some cases items that were standard appear to have become optional.

FUTURE DEVELOPMENT

It is considered that the significant shift in the market achieved in just one year of publishing the rating is an excellent achievement. In 2024, many of the systems required will become mandatory in Europe because of the revised General Safety Regulation. However, because in order to get the higher ratings, Euro NCAP requires higher performance than the mandatory minimum, it is proposed that the scheme continues on the basis of following the developments in the car testing protocol but one generation behind passenger cars. It is also proposed that the short term measure of testing the best specification available is ended, such that standard fitment of safety equipment is required.

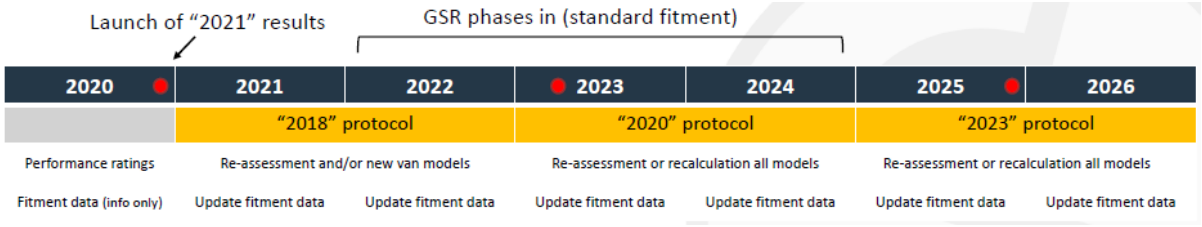


Figure 11: Timeline of van rating development

CONCLUSIONS

Both usage and accidentology data suggest that the safety problems experienced by vans is more closely related to that of passenger cars than heavier commercial vehicles. However, the end customer is likely to be different. In many cases, these will be fleet managers either within the freight industry or within technical and engineering industries such as construction, servicing, maintenance etc.

Analysis of collision data, crash tests and safety feature fitment data all supported the view that van safety lagged significantly behind passenger car safety.

[1] It should be noted that in the definition above Occupant Status Monitoring (OSM) only included seat belt reminders and not direct driver monitoring

Issues of crash compatibility between large and heavy vans and passenger cars remain a concern and is an area in need of further study.

A rating scheme focussed on helping van drivers to avoid collisions has been developed and a full assessment of the market in two subsequent years has found a dramatic improvement in the performance of vehicles on the market.

Aligned with forthcoming new legislation in the EU, EuroNCAP will move to rating only standard fit equipment by 2025 and will driver performance in that equipment over and above the minimum required by law.

REFERENCES

[1] Euro NCAP, 2017. “2025 Roadmap: In pursuit of vision zero” Brussels: Euro NCAP

[2] Browne, M., Rizet, C. & Allen, J., 2014. A comparative assessment of the light goods vehicle fleet and the scope to reduce its CO2 emissions in the UK and France. s.l., Elsevier Ltd., proceedings of the 8th International conference on city logistics.

[3] Knight & Edwards, 2010. A preliminary analysis of the risks and benefits of selected vehicle safety interventions for accidents involving light commercial vehicles (LCVs) or minibuses. TRL Published project Report PPR 516

[4] Clarke, Johnson, Nankivell & Turpin, 2014. Van travel trends in Great Britain, s.l.: RAC Foundation