

Rearward Visibility Technology in ASEAN Market

M. A. Meor Said^{*1}, M. H. F. Mohd Sohimin¹, N. Abu Husain², B. Abd Rahman³, T. N. A. Tuan Kamaruddin⁴, S. N. Mohamad Jamil⁴ and R. Balaka⁵

¹Dept. of Mech. Eng., Uni. Teknologi PETRONAS, 32610 Seri Iskandar, Perak, Malaysia

²School of Mechanical Eng., Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

³Perusahaan Otomobil Nasional Sdn. Bhd., 40400 Shah Alam, Selangor, Malaysia

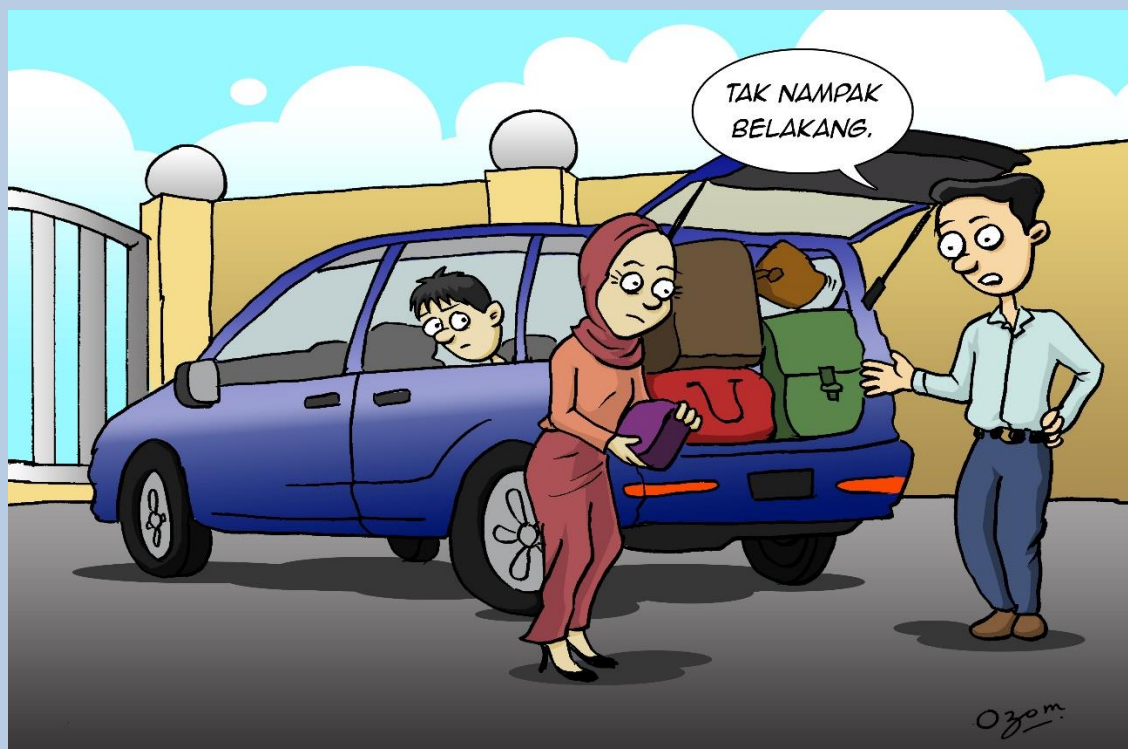
⁴International Islamic Uni. Malaysia, 50728 Kuala Lumpur, Malaysia

⁵Mechanical Eng. Dept., Halu Oleo University, Sulawesi Tenggara 93232, Indonesia

**Corresponding author: miorazman@utp.edu.my*

Car-TOON

Open Access



The recent trend in vehicle design tends to make thick roof pillar for stronger structure; which results in limiting rearward visibility. One of the ways to circumvent this reduced visibility is by using Rearward Visibility Technology (RVT). This paper aims to produce an overview of RVTs available in the ASEAN market based on classes and sub-classes. In summary, RVT is still in the introductory phase to the ASEAN region; as RVTs only been implemented by OEMs in several models, and aftermarket RVT products offer cost-effective prices but the performance in comparison to OEM's RVT is yet to be known.

Ozom or his real name, Norhasram Mohamad, is a legendary cartoon artist (Gelagat magazine 1991-1997) currently based in Pasir Puteh, Kelantan, Malaysia. His Facebook page is www.facebook.com/hasram.ozom.

Keywords: Rearward Visibility Technology (RVT), Class I Mirror, Class III Mirror, ASEAN NCAP Roadmap 2021-2025

Article History:

Received
17 Nov 2019

Received in revised form
10 Mar 2020

Accepted
10 Mar 2020

Available online
1 May 2020

Copyright © 2020 Society of Automotive Engineers Malaysia - All rights reserved.

Journal homepage: www.jsaem.saemalaysia.org.my

Rearward visibility is an important aspect for vehicle drivers to securely steer the direction of the vehicle on the road. However, the modern vehicle design trend tends to opt for bigger A, B, C, and D pillar due to consideration for stronger structure, drag coefficient reduction and styling improvisation (Hughes et al., 2009). This reduces the visibility of drivers and increase the difficulty of drivers to detect not only other cars but also other motorcycles and pedestrians.

In the ASEAN region, rear visibility technology and solutions become important and need further in-depth study in comparison to other regions due to the fact that MPVs and SUVs are gaining popularity, and starting to dominate sales in the ASEAN market since 2017 (Santosa et al., 2018; Focus2move, 2019). This might be due to the big number of family members (Ab Rashid and Jawi, 2019), and the tendency to carry the luggage that fills to the brim. Higher motorized two- and three-wheeler fatalities in ASEAN was reported by WHO (2018), and this proves the need to look into improving motorcycle conspicuity on the road (Solah et al., 2019); which relates to the rearward visibility of vehicles (Compagne, 2008).

According to the ASEAN NCAP 2021-2025 roadmap (ASEAN NCAP, 2018), and the current ASEAN NCAP evaluation spreadsheet (ASEAN NCAP, 2019), vehicle rearward visibility importance is signified via new evaluations under Rear View Technology and Advanced Motorcyclist Safety Technology of the Motorcyclist pillar. In the United States, the National Highway Traffic Safety Administration (NHTSA) has begun a feasibility study of rearward visibility technology to replace conventional vehicle mirror in August 2019 (NHTSA, n.d.). These are two examples where rearward visibility of vehicles being placed as important criteria for vehicle safety by governing authorities.

Global Outlook on Rearward Visibility Technology (RVT)

Car manufacturers have begun to improvise the rear-view and side-mirror functionality to enhance rearward visibility. High-pixel cameras and panel display has been installed or to aid the conventional mirrors for better drivers' visibility. The first car manufacturer to market this technology is General Motor in 2016 with Cadillac and after that Nissan with Armada in 2018 (Omdia, 2017).

Figure 1 (a) displays the projected global production of the rear-view display mirror by IHS Markit (Omdia, 2017). Based on current law enacted and reception by motorists, it is forecasted that 1.8 million units of rear-view display mirrors to be manufactured by 2025, with a market concentration in Japan and North America (Omdia, 2017).

It is also forecasted that by 2025, that close to 0.5 million number of vehicles with conventional side-view mirror will be replaced by the camera system, as shown in Figure 1 (b) (Omdia, 2017). About 1.8 million vehicles are expected to use the side-view camera system, which amounted to 23 % of the total vehicles in the world (Omdia, 2017).

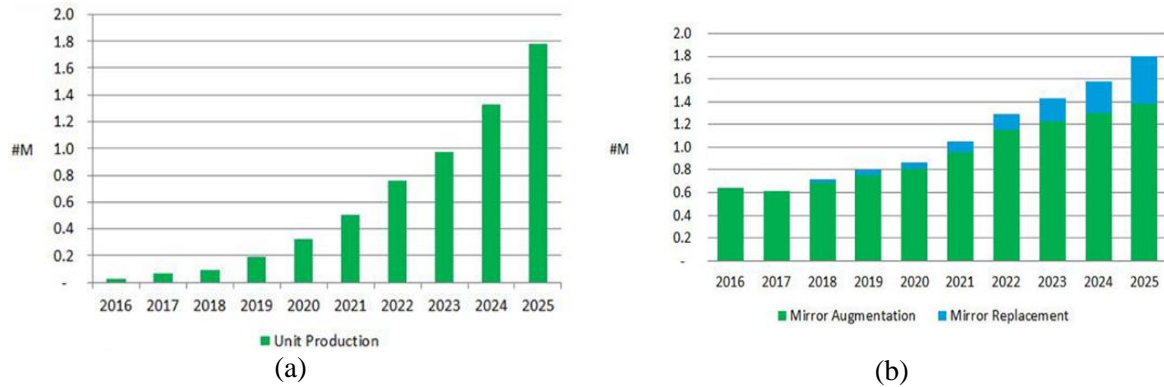


Figure 1: (a) Projected global production of rear-view display mirror; (b) Forecasted side-view mirror replacement with camera display system (Omdia, 2017)

RVT in ASEAN Market

We can group RVT in ASEAN in two major categories – OEM and aftermarket – as shown in Figure 2 below:

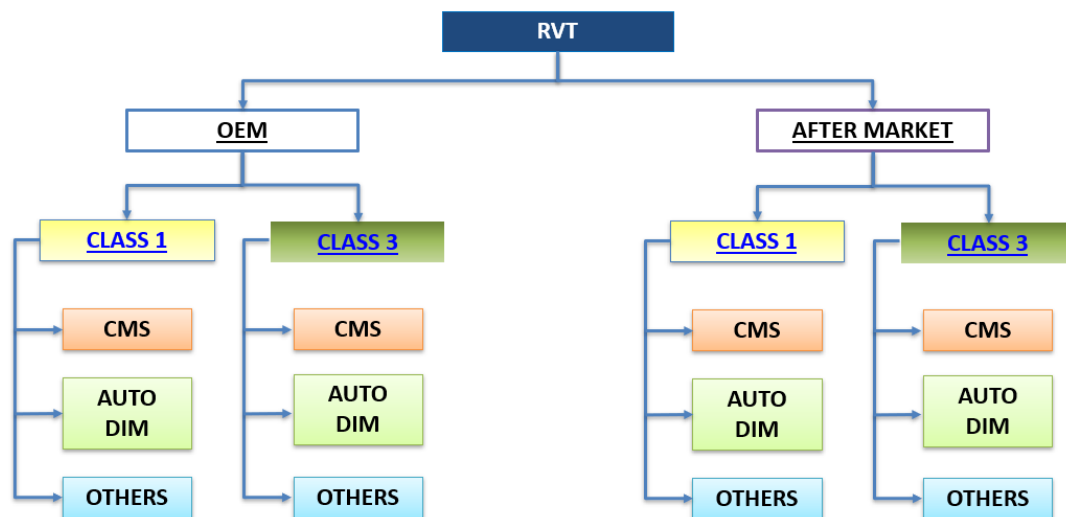


Figure 2: Categorization of RVT in the ASEAN market

The two major groups can be further divided into two classes: Class 1 and Class 3 that correspond to the classification made by United Nations Economic Commission for Europe (UNECE) in UN R46 Regulations (UNECE, 2013). Class 1 refers to the rear-view mirror that is located inside the car while Class 3 refers to the side mirror located outside the car. Figures 3 and 4 show the Class 1 and 3 performance requirements for rear-view and side mirror under UN R46 regulations.

Further categorization of RVT involves Camera Monitoring System, Auto-Dim and Others. Camera Monitoring System includes the use of a digital camera for rearward visibility while Auto-Dim refers to the use of mirrors that have the ability to dim the light striking on the glass panel. This reduces the glare to the driver's eye and enhance the driver's performance on the road. For the 'others' category, related technology concerning RVT is described in the subsequent sections.

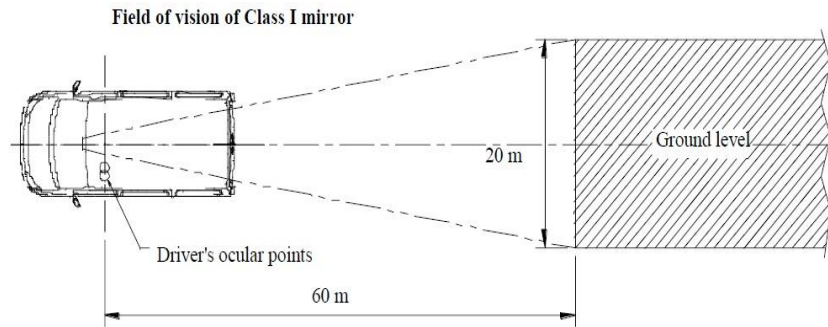


Figure 3: Class I performance requirement based on UN R46 (UNECE, 2013)

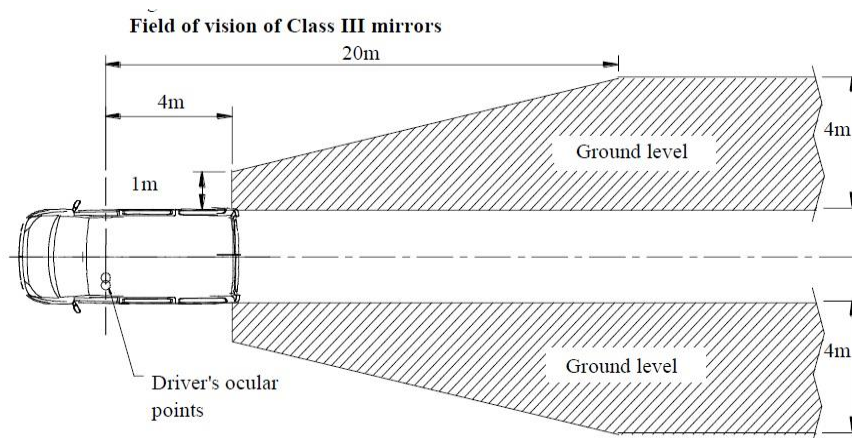


Figure 4: Class III performance requirement based on UN R46 (UNECE, 2013)

Original Equipment Manufacturer (OEM): RVT CMS Class I

In the ASEAN region, the introduction of RVT CMS Class I takes two years later than the first OEM RVT car, Cadillac CT6 in 2016. The first RVT Class I introduced in ASEAN is Nissan Terra in 2018 and followed by Toyota RAV4 in 2019. Both are Sport Utility Vehicle (SUV), which in line with the trend of initial RVT in the market. Table 1 shows the detail of the OEM RVT Class I for the Nissan Terra and Toyota RAV4.

Original Equipment Manufacturer (OEM): RVT Auto-Dim Class I

In all ASEAN countries, Subaru and Honda include Auto-Dim technology in Class I mirror in the Subaru STI and Honda Civic model, respectively, shown in Table 2 below. Both are in C-Segment only and the price is in the range of above MYR 100,000. Both Auto-Dim RVTs activated when high-intensity light strikes the rear-view mirror. However, Subaru STI Auto-Dim can be connected to Homelink radio-frequency control system devices which normally interconnected with be garage door, home gate, home lighting system, etc.

Table 1: OEM RVT CMS Class I in the ASEAN market (Nissan, n.d.; Teague, 2019)

Vehicle Model	Market Availability	Vehicle Segment	Price	RVT Features
Nissan Terra (2018)	<ul style="list-style-type: none"> • Filipina • Thailand • Indonesia • Brunei • Cambodia • Laos • Myanmar • Vietnam 	J-segment (medium SUV)	MYR 113,522	<ul style="list-style-type: none"> - It has 360 bird's eye view projected on the Intelligent Rear View Mirror - The rear-view mirror can see beyond objects which obstruct the driver's view - This RVT has dual-mode: digital mirror and normal mirror
Toyota RAV4 (2019)	<ul style="list-style-type: none"> • Singapore 	J-segment (small SUV)	SGD 119,988	<ul style="list-style-type: none"> - It has digital rearview mirror latency at 80ms (0.08s) - RVT can see a complete, unobstructed view of what is happening behind drivers which includes car pillars and passengers - The mirror can be in dual mode: digital mirror and normal mirror

Table 2: OEM RVT Auto-Dim Class I in the ASEAN market (Hondapartsnow, n.d.; Subarupartspros.com, n.d.)

Vehicle Model	Market Availability	Vehicle Segment	Price	RVT Features
Subaru STI (2017)	All ASEAN countries	C-segment	MYR 314,947.00	<ul style="list-style-type: none"> - Auto-dimming mirror activated when high-intensity light from car behind striking the Class I mirror - This RVT can be connected to Homelink radio-frequency control system devices
Honda Civic (2019)	All ASEAN countries	C-segment	MYR 108,165.00	<ul style="list-style-type: none"> - Auto-dimming mirror activated when high-intensity light from car behind striking the Class I mirror

Original Equipment Manufacturer (OEM): RVT CMS Class III

In the ASEAN region, as is now, only Audi introduces RVT CMS for the Class III mirror on its Electric Vehicle (EV) model - Audi E-tron 55 Quattro. Some detail of this RVT is shown in Table 3 below. This digital side-view mirror improves the aerodynamic of the EV by reducing the drag coefficient from 0.28 to 0.27 as the mirror has been made smaller. The NVH of the EV also being claimed as been reduced by the addition of the RVT. The side view mirror also includes a heater which maintains the mirror view clear from fog and mist on the cameras.

Table 3: OEM RVT CMS Class III in ASEAN Market (Top Gear, n.d.)

Vehicle Model	Market Availability	Vehicle Segment	Price	RVT Features
Audi E-tron 55 Quattro (2018)	<ul style="list-style-type: none"> Thailand 	E-segment (Electric Vehicle)	THB 5.099 million	<ul style="list-style-type: none"> - Reduce the drag co-efficient of the EVj from 0.28 to 0.27 due to smaller camera design than normal size mirror - Side-mounted cameras are heated to keep the view clear from fog forming on the cameras - The digital mirror display is only 110 ms lag from the physical view - This addition of digital side-view mirror improves NVH of the EV

Aftermarket: RVT CMS Class I

There are three major players in ASEAN for the aftermarket RVT CMS Class I product which is shown in Table 4 below. The price range varies from MYR 374 to MYR 1,695 depending on the additional features in the camera system. Gentex, which on the high price, includes an auto-dimming feature on the camera display, which is a very important element in the sunny region such as ASEAN. CAMONS have come up with a good value for money camera system, which includes special features such as Wide Dynamic Range (WDR) technology, which made picture captured in any lighting conditions and also includes motion detection function – auto-recording ability when the car is in parking mode. Low-cost RVT Awesafe provides competitive features and also includes auto-recording ability while vehicle in parking mode by sensing vibration.

Aftermarket: RVT Auto-Dim Class III

For the RVT Auto-Dim Class III product in the aftermarket, only RVT camera by Gentex is available in the ASEAN market. The details are shown in Table 5 below. It is a value-for-money mirror with a basic Auto-Dim feature on the mirror with just MYR 460 in price.

Aftermarket: Other Related RVT

This section specifies the other related RVT items which improve drivers' rearward visibility on the road. In general, these products are cheap and easily installed to mirrors, as shown in Table 6 below. OkcityGo offers rain-proof thin film as cover for side view mirror from fog, glare, and mist. A non-specified brand offers a 360-degree adjustable mirror that is attached to the side view mirror as shown in Figure 5.

Table 4: Aftermarket RVT CMS Class I in ASEAN Market (Lazada, n.d.a)

Brand	Market Availability	RVT Type	Price	RVT Features
Gentex	All ASEAN countries	CMS with Auto-Dim Mirror	MYR 1,695.50	<ul style="list-style-type: none"> - Auto-dimming mirror when the vehicle behind produce high-intensity light that can cause glaring for the driver - Mirror can convert into a digital screen to project rearview camera images (if any)
CAMONS	All ASEAN countries	CMS and Mirror	MYR 408.00	<ul style="list-style-type: none"> - RVT includes WDR technology in which the system recalculates light camera exposure to create balanced images and videos in any light conditions - Integrated G-sensor will auto-lock the recorded important video clip as evidence when a collision happens - While the car is parked, the motion detection function will trigger auto recording when detected any moving objects
Awesafe	All ASEAN countries	CMS	MYR 374.66	<ul style="list-style-type: none"> - Variable sensitivity G-sensor auto detects a sudden shake or collision and emergency locks the footage to "Event File" to prevent that video from an overwrite - With parking monitoring enabled, if any vibration is detected by the G-Sensor, it will automatically turn on the dashcam and begin recording

Table 5: Aftermarket RVT Auto-Dim Class I in ASEAN Market (Lazada, n.d.a)

Brand	Market Availability	RVT Type	Price	RVT Features
Gentex	All ASEAN countries	Mirror	MYR 460.20	<ul style="list-style-type: none"> - Auto-dimming mirror when the vehicle behind produce high-intensity light that can cause glaring for the driver



Figure 5: 360-degree adjustable blind spot mirror (Lazada, n.d.b)

Table 6: Other related aftermarket RVT products in ASEAN Market (Lazada, n.d.b)

Brand	Market Availability	RVT Type	Price	RVT Features
OkcityGO	All ASEAN countries	Thin Film	MYR 10.00	<ul style="list-style-type: none"> - The film protects the mirror Anti-Fog Film - Rainproof material - Anti-glare - Anti-mist
Non-Specified*	All ASEAN countries	Mirror for Blind Spot	MYR 19.40	<ul style="list-style-type: none"> - The mirror can be rotated 360° and adjusted 30° sway - The mirror is a 2-inch curved-surface glass, ultrathin design, made by waterproofed and rust-resistant material

*The item was displayed online on Lazada.com.my without the detail of the original manufacturer

Conclusion

This review paper has given an overview of Rearward Visibility Technology (RVT) being offered in the ASEAN Market, together with a brief outlook on the global market. In general, OEM still treated RVT as complementary features rather than elementary in ASEAN Market. Most vehicles with OEM RVT are at the premium price range with notable OEM RVT Class III Mirror only featured on Electrical Vehicle – Audi E-tron 55 Quattro. For RVT Auto-Dim, the technology only available in C-segment cars: Subaru STI 2017 and Honda Civic 2019. This reflects that the OEM still testing the marketability of RVT and not ready for the holistic adoption of RVT in all of their segments. There are several good cost-effective RVT CMS available in the aftermarket, and the price range reflects their additional feature and quality of the display. Other related RVT includes the accessories that improve driver's rearward visibility which focuses more on the protection of side-view mirror from fog, mist, and glare.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the assistance and guidance given by the Malaysian Institute of Road Safety Research (MIROS) and ASEAN NCAP secretariat through the ASEAN NCAP Collaborative Holistic Research (ANCHOR) programme.

REFERENCES

- Ab Rashid, A.A., & Jawi, Z.M. (2019). Improvement of psychosocial supportive mobility through 7-seater vehicles: The scope of Child Restraint System. *Journal of the Society of Automotive Engineers Malaysia*, 3(1), 89-95.
- ASEAN NCAP (2018). *ASEAN NCAP Roadmap 2021-2025*. Malaysian Institute of Road Safety Research (MIROS), Kajang.

- ASEAN NCAP (2019). *ASEAN NCAP New Protocol 2021-2025 (Spreadsheet Version)*. Retrieved from <http://www.aseancap.org/v2/?p=4416>
- Compagne, J. (2008). *MAIDS: Motorcycle Accidents In-Depth Study*. ITF: Lillehammer, Norway.
- Focus2move (2019). *Focus2move Markets Outlook*. Retrieved from <https://focus2move.com/category/market-outlook>
- Hondapartsnow (n.d.). *Automatic Dimming Mirror*. Retrieved from <https://www.hondapartsnow.com/genuine>
- Hughes, C., Glavin, M., Jones, E., & Denny, P. (2009). Wide-angle camera technology for automotive applications: a review. *IET Intelligent Transport Systems*, 3(1), 19-31.
- Lazada (n.d.a). *Gentex, auto-dimming mirror*. Retrieved from <https://www.lazada.com.my>
- Lazada (n.d.b). *Universal automotive exterior mirrors rainproof waterproof film*. Retrieved from <https://www.lazada.com.my>
- NHTSA (n.d.). *Visibility*. Retrieved from <https://one.nhtsa.gov/Research/Human-Factors/Visibility>
- Nissan (n.d.). *Nissan Terra: Nissan Intelligent Mobility*. Retrieved from <https://www.nissan.ph/vehicles/new/terra/nissan-intelligent-mobility.html>
- Omdia (2017). *Press Release: New camera and display mirrors enhance vehicle safety and fuel efficiency, challenging traditional mirror solutions, IHS Markit says*. Retrieved from <https://technology.informa.com/595595/new-camera-and-display-mirrors-enhance-vehicle-safety-and-fuel-efficiency-challenging-traditional-mirror-solutions-ihs-markit-says>
- Santosa, S.P., Jusuf, A., Gunawan, L., Abu Kassim, K.A., Hakim, M.L., & Wiranto, B.P.E. (2018). Rollover risk probability analysis for SUVs and MPVs in the ASEAN market. *Journal of the Society of Automotive Engineers Malaysia*, 2(3), 275-288.
- Solah, M.S., Hamzah, A., Jawi, Z.M., Ariffin, A.H., Paiman, N.F., Isa, M.M., & Khalid, M.S. (2019). The requisite for motorcycle personal protective clothing: Malaysia's perspective. *Journal of the Society of Automotive Engineers Malaysia*, 3(1), 74-83.
- Subarupartspros.com (n.d.). *Subaru Auto Dimming Mirror W/ Compass & Homelink*. Retrieved from <https://www.subarupartspros.com/sku/h501sfj101.html>
- Teague, J. (2019). *How to improve visibility in your 2019 Toyota RAV4*. Retrieved from <https://www.torquenews.com/6626/how-improve-visibility-your-2019-toyota-rav4>
- Top Gear (n.d.). *Review: Audi E-Tron 55 Quattro*. Retrieved from <https://www.topgear.com/car-reviews/audi/e-tron/owninghttps%3A/www.carmagazine.co.uk/car-news/tech/audi-e-tron-virtual-mirrors-how-does-it-work>
- UNECE (2013). *United Nations Regulations No. 46*. United Nations E/ECE/324/Rev.1/Add.45/Rev.5–E/ECE/TRANS/505/Rev.1/Add.45/Rev.5
- WHO (2018). *Global Status Report on Road Safety 2018*. World Health Organization, Geneva.