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Development and trial of a process to audit vehicle safety technologies in rural areas

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TITLE

Development and trial of a process to audit vehicle safety technologies in rural areas

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ABSTRACT

The purpose of this pilot project was to devise and trial a method by which the safety technologies of a sample of the vehicle fleet in South Australia could be identified and compared between vehicles being used in metropolitan areas and rural areas. The trialled method proved successful in collecting vehicle data, associated with location. The collected data was analysed in several ways to showcase what would be possible with a large study. Alternative methods that may offer more accurate results were discussed.

KEYWORDS

South Australian vehicle fleet, vehicle technologies, rural, ANCAP ratings

Summary

A method to determine the prevalence of vehicle safety technologies throughout a region was devised by attaching Automatic Number Plate Recognition (ANPR) cameras to a vehicle, linking captured number plates to registration data, then linking registration data to vehicle-specific ANCAP data. Multiple vehicle safety technologies were explored, comparing the prevalence of each technology in metropolitan and rural areas.

The vehicle technologies that were explored included seatbelts, airbags, braking technologies, Autonomous Emergency Braking (AEB), headlight systems, Electronic Stability Control (ESC), fatigue detection and reminders, Forward Collision Warning (FCW), lane support systems, speed assistance systems and blind sport warning technologies.

Some alternative methods of data collection and registration matching have also been explored.

Note that this report was substantially completed in February 2022 and does not consider developments after that date.

Contents

1 Introduction

A commonly suggested strategy for reducing road trauma in Australia is increasing the prevalence of modern vehicle safety technologies within the fleet. Actions under this strategy include encouraging private buyers and mandating fleet buyers to purchase vehicles ranked 'safer' (a higher star rating) by the renowned Australasian New Car Assessment Program (ANCAP). Vehicle safety technologies, such as lane departure warning systems, have been shown to have a higher potential to be effective in rural areas compared with urban areas (Gordon et al., 2010). While it is imperative for the strategy actions to continue, it is important to understand the vehicle fleet, in particular, the range of vehicles being used in different locations and what modern safety technologies they are equipped with.

Ponte et al. (2022) outlined the complexities in determining the prevalence of safety technologies in the vehicle fleet and provided a variety of methods to do so, one of which is used in this project.

Registration records of vehicles do list locations, but it is well known that this may not always be a valid representation of where a vehicle is being driven. For example, a company vehicle may be registered in a city-based head office but drive significantly in a rural area. Similarly, a vehicle may be registered in a parent's name and address for insurance purposes but driven by an adult child in a completely different area. There are also issues of exposure to consider. Even if it was known where a vehicle was based, there is no way to tell how much it is being driven.

The purpose of this pilot project was to trial a method of collecting the data necessary to conduct an audit of the prevalence of safety technologies in the South Australian active vehicle fleet, then explore what can be done with that data.

To determine the prevalence of vehicle safety technologies in the South Australian active vehicle fleet, several pathways were identified, each with their own ramifications such as accuracy, time, and cost. Three main phases were established in the process to determine safety technology prevalence:

- video/photography capturing of vehicle number plates,
- identification of the vehicle makes, models, trims, and manufacture years, and
- matching of the safety technologies to each variety of vehicle.

For the first phase, automation was necessary due to the large sample size desired. Automatic Number Plate Recognition (ANPR) systems are complex to self-design given the range of scenarios they may operate under, but fortunately they are commercially available. Any high-quality camera could theoretically be equipped with an ANPR system to record the number plates of vehicles detected. Commercially available systems which were suitable to this project included fixed stationary roadside cameras, in-vehicle mounted cameras, or software designed to analyse a camera feed. An in-vehicle camera system was hired for this project for simplicity, reliability, and efficiency purposes.

For the second and third phases, the recorded list of number plates needed to be matched to a specific vehicle, and a set of vehicle technologies. There are multiple providers who offer data-matching services. Two separate data providers were selected for this project for each of the phases.

This report is laid out in the following way:

- Section 2: An explanation of the method used for data collection and data matching.
- Section 3: An exploration of the data that was collected.
- Section 4: A discussion on the suitability of the trial method, how the data could be useful, and what a larger study may look like.

2 Methodology

To determine the prevalence of safety technologies in vehicles throughout the South Australian fleet, a sample of vehicle details was collected, followed by the identification of safety technologies installed in each vehicle. The methodology in this report has been divided into three sections: data collection, registration matching, and data analysis.

In general, Figure 2.1 outlines the process used to assign vehicle safety technologies to individual vehicle number plates.

Cameras capture number plates of vehicles → Vehicle makes, models and years matched to number plates → Vehicle safety technologies matched to vehicle makes, models and years

Figure 2.1
Process of assigning vehicle safety technologies to captured vehicles

An ethics application was approved by the University of Adelaide's Office of Research Ethics, Compliance and Integrity with approval number H-2021-128. A risk assessment was also completed for the data collection process.

2.1 Data collection

A camera-based system was hired from AeroRanger, a company based in Perth, Western Australia. The system included two cameras, a controller box, and all necessary connecting cables, as shown in Figure 2.2.

Figure 2.2
Components of AeroRanger ANPR system

The camera system was equipped with Automatic Number-Plate Recognition (ANPR) technology to automatically detect the number plates of vehicles within view of the cameras. The cameras were mounted internally on the windscreen of a testing vehicle, facing the front of the vehicle (shown in Figure 2.3), and the system was powered by the vehicle's 12V battery. When the system was active, the ANPR technology would detect number plates of vehicles in view of the cameras and upload the details, GPS location, and a supporting photograph to a password-protected server.

Figure 2.3
AeroRanger cameras mounted to windscreen of test vehicle

The test vehicle was driven by researchers to various rural locations close to Adelaide on weekdays throughout two weeks in August 2021, collecting number plates of vehicles in both metropolitan and rural areas.

A metropolitan/rural zone was defined using the 2016 ABS Remoteness Areas map, which includes five levels of remoteness: Major Cities of Australia, Inner Regional Australia, Outer Regional Australia, Remote Australia, and Very Remote Australia. For this study, data collection only occurred in the first two listed areas, which defined the metropolitan-rural split. The locations of number plate detection locations and the boundary used for the metropolitan-rural split is shown in Figure 2.4.

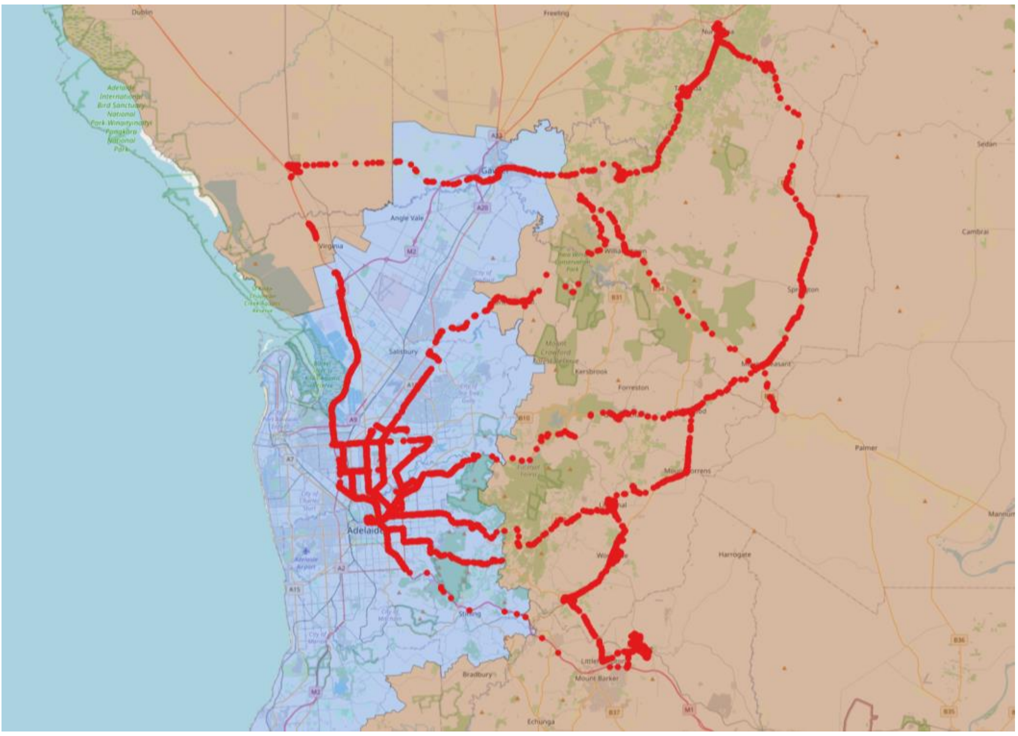

Figure 2.4
Locations of number plate detections and metropolitan-rural boundary

2.2 Registration matching

The number plates of detected vehicles were submitted to a data provider at the Department for Infrastructure and Transport (DIT), who provided (in-kind) de-identified, most recent registered vehicle record makes, models and production years matched to each number plate.

2.3 Data analysis

The Australasian New Car Assessment Program (ANCAP) provided detailed data on the vehicle technologies of each vehicle they have tested, of which were relevant to this project are listed in Table 2.1.

Table 2.1
Vehicle safety technologies recorded by ANCAP relevant to this project

Category	Safety technologies	
Occupant protection	• Airbags installed (Frontal (driver), frontal (passenger), side (front seats), side (2nd row), side (3rd row), curtain (front seats), curtain (2nd row), curtain (3rd row), centre, knee (driver), knee (front passenger) • Head restraints • Inflatable seat belts • Integrated child seat	• Intelligent seat belt reminder • ISOFIX • Rollover occupant protection system • Seat belt pretensioners • Seat belts (three-point) for all forward-facing seats • Top tether anchorages for child restraints
Crash avoidance and mitigation	• Anti-lock Braking system (ABS) • Active bonnet • Adaptive Cruise Control (ACC) • Autonomous Emergency Braking (AEB) – City, Interurban, Vulnerable Road User, Backover, Junction Assist • Blind spot monitoring • Emergency Brake Assist (EBA) • Electronic Brakeforce Distribution (EBD) • Electronic Stability Control (ESC) • Emergency Stop Signal (ESS)	• Fatigue detection • Fatigue reminder • Forward Collision Warning (FCW) • Intersection collision warning • Lane Departure Warning (LDW) • Lane Keep Assist (LKA) • Rear Cross Traffic Alert (RCTA) • Reversing collision avoidance • Roll stability system • Secondary / multi-collision brake
Speed management	• Speed alarm • Speed assistance - auto / intelligent speed limiter • Speed assistance - manual speed limiter	• Speed assistance - speed sign recognition & warning • Speedometer scale & display
Headlights	• Adaptive headlights • Automatic headlights	• Automatic high beam • Daytime running lights
Other	• Alcohol / drug interlock • ANCAP rating • Automatic Emergency Call (eCall) • Child presence alert • Electronic Data Recorder (EDR) • Hill launch assist • Night vision enhancement	• Seat belt interlock • Tyre Pressure Monitoring System (TPMS) • Trailer stability control • Vehicle-to-Infrastructure communication (V2I) • Vehicle-to-Vehicle communication (V2V) • Workload manager

Each ANCAP tested vehicle was attributed with a variable for each vehicle safety technology. The variables were as listed:

- Standard on all variants
- Optional
- Not available on base variants, but standard or optional on higher variants
- Not available
- Unknown

- Available in Europe but not available on Australian or New Zealand variants.

For the sake of simplicity, some categories have been grouped together in the results. ‘Optional’ and ‘Not available on base variants’ have been combined as the variants of collected vehicles were not identified in this study. ‘Not available’ and ‘Available in Europe’ have also been combined as this study targets vehicles driven in Australia only.

3 Data exploration

The intention of this project was not to conduct a formal data collection to identify any representative results. Rather, it was to explore the feasibility of conducting a larger project and provide some insight of what could be achieved through a larger project.

A total of 11,372 unique vehicle number plates were collected in the data collection phase. There were 10,760 unique number plates that were matched to registration data, specifying the makes, models, and production years of the vehicles. Of those, 8,333 were matched to an ANCAP listed vehicle.

There were 612 number plates that were unable to be linked to registration data. The cause of this could be that these vehicles were registered in a state other than South Australia or there was a misreading of the number plate by the ANPR software.

There were 2,427 vehicles that were unable to be matched to an ANCAP rating. These vehicles may have been of a type other that a passenger vehicle (e.g. truck, bus, motorcycle, etc.) or they may have been unrated by ANCAP. Vehicles were first officially rated by ANCAP in 1999 and there were 432 vehicles with a registered manufacturing year earlier than 1999, which was 4.0% of the registered vehicles sample. There may have been safety technologies installed in the vehicles but, as the selected method incorporated ANCAP data only, they were excluded from the analysis.

A flow chart of the data matching and selection of vehicles for analysis is shown in Figure 3.1.

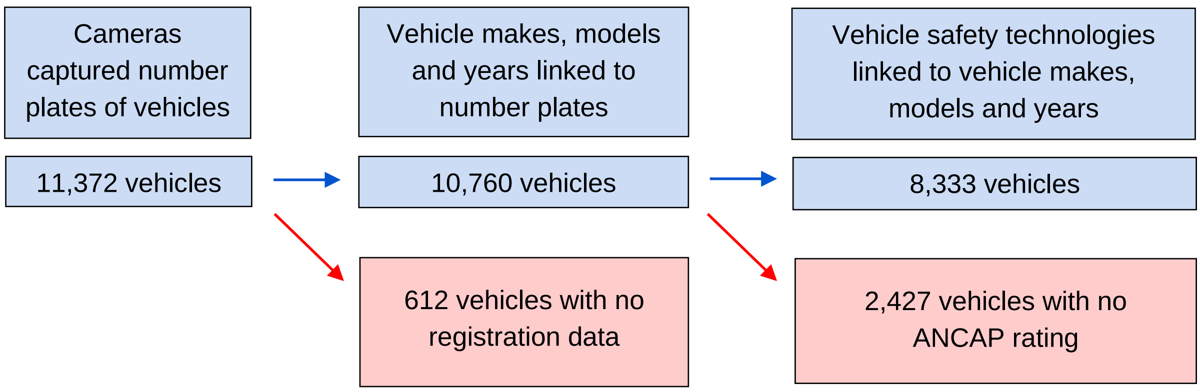

Figure 3.1
Vehicle counts for process of assigning vehicle safety technologies to captured vehicles

3.1 Sample characteristics

Of the sample of 8,333 vehicles there were 5,981 (71.8%) detected in metropolitan areas and 2,352 (28.2%) detected in rural areas (according to the boundary outlined in Figure 2.4). Although the aim of this project was to focus on the vehicle technologies in rural areas, there was a naturally high number of vehicles in the metropolitan areas detected during the commutes to the rural areas, which was used as a comparison base.

3.1.1 Vehicle manufacturers

The three most popular vehicle manufacturers detected in both metropolitan and rural areas were Toyota, Mazda and Holden. Table 3.1 shows the counts and proportions of various vehicle makes of the vehicles that were matched with registration data (sample size of 10,760 vehicles).

Table 3.1
Manufacturers of vehicles in metropolitan and rural zones

Vehicle manufacturer	Count		Percentage	
	Metropolitan	Rural	Metropolitan	Rural
Audi	75	37	1.0%	1.2%
BMW	129	35	1.7%	1.2%
Fiat	17	4	0.2%	0.1%
Ford	603	290	7.8%	9.6%
Hino	29	20	0.4%	0.7%
Holden	818	372	10.6%	12.3%
Honda	300	108	3.9%	3.6%
Hyundai	467	204	6.0%	6.8%
Isuzu	125	60	1.6%	2.0%
Jeep	54	15	0.7%	0.5%
Kia	171	87	2.2%	2.9%
Land Rover	49	17	0.6%	0.6%
Lexus	40	20	0.5%	0.7%
Mazda	731	220	9.4%	7.3%
Mercedes Benz	160	50	2.1%	1.7%
MG	17	4	0.2%	0.1%
Mitsubishi	599	222	7.7%	7.4%
Nissan	417	157	5.4%	5.2%
Peugeot	27	5	0.3%	0.2%
Renault	54	19	0.7%	0.6%
Scania	19	9	0.2%	0.3%
Skoda	23	5	0.3%	0.2%
Subaru	329	128	4.2%	4.2%
Suzuki	136	71	1.8%	2.4%
Toyota	1791	639	23.1%	21.2%
Volkswagen	298	109	3.8%	3.6%
Volvo	35	11	0.5%	0.4%
Other	230	99	3.0%	3.3%
Total	**7743**	**3017**	**100.0%**	**100.0%**

3.1.2 Vehicle production years

The vehicle production years for all registered vehicles (sample size of 10,760 vehicles), split by rural and metropolitan areas is shown in Figure 3.2. For the example data collected in this trial, the average manufacture year of vehicles was 2011 for both the metropolitan regions, and the rural regions.

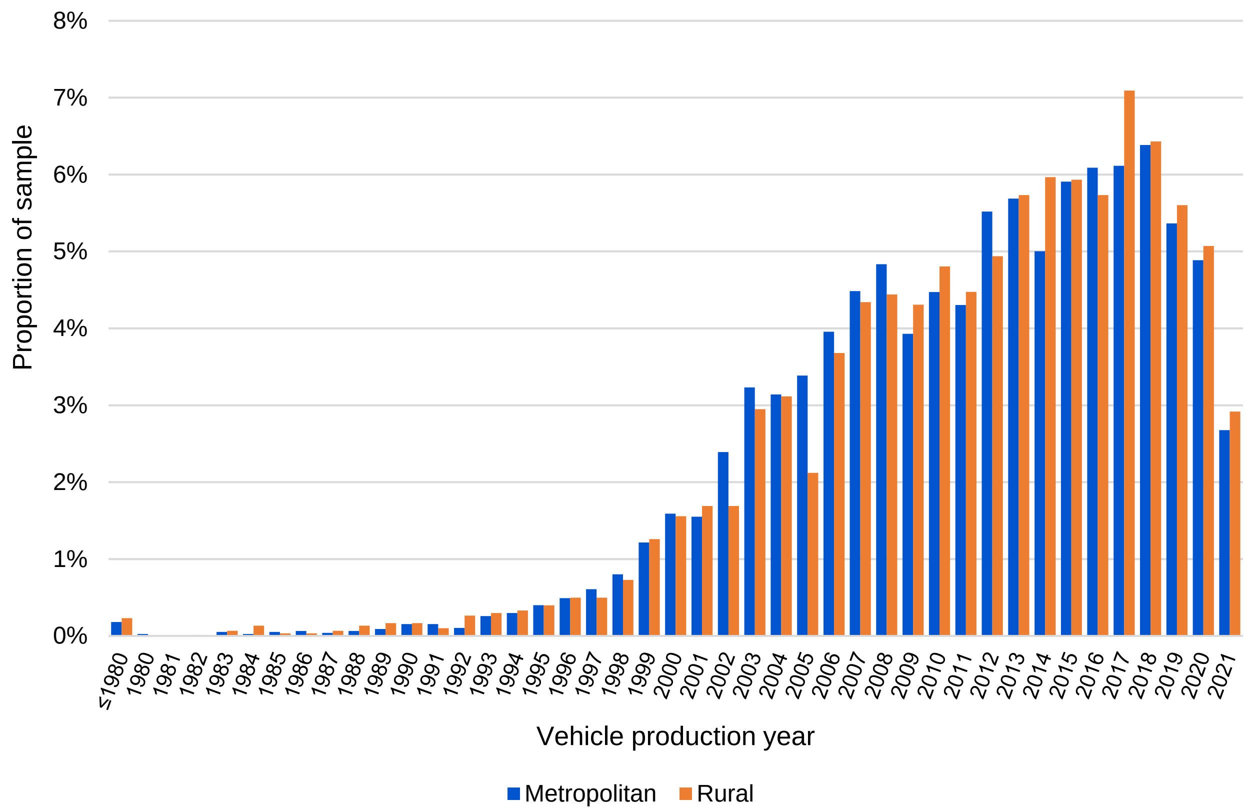

Figure 3.2
Proportions of vehicle manufacture years in registered vehicle sample, split by metropolitan and rural zones

3.2 ANCAP ratings

As the oldest vehicle with an ANCAP rating was produced in 1999, so vehicles that were produced prior to 1999 were removed from the sample. The effect of removing vehicles manufactured before 1999 is that the results will be skewed towards newer vehicles.

Each vehicle rated by ANCAP received a score based on the protection the vehicle provided to its occupants and vulnerable road users, as well as the presence and performance of on-board safety features and technologies. A 5-star rating indicates the highest safety level for a vehicle in its production year. Close to 72% of vehicles in metropolitan areas had the highest rating of 5 stars, along with close to 73% of vehicles in rural areas. Table 3.2 shows the distribution of ANCAP safety ratings for the collected vehicles (sample size of 8,333 vehicles), split by metropolitan and rural regions.

Table 3.2
ANCAP safety ratings of detected vehicles in metropolitan and rural zones

ANCAP safety rating		Metropolitan	Rural
5-star	★★★★★	71.9%	73.1%
4-star	★★★★	22.3%	21.8%
3-star	★★★	5.2%	4.6%
2-star	★★	0.6%	0.5%
1-star	★	0.0%	0.0%

The trends of ANCAP safety ratings for each manufacture year is shown in Figure 3.3 with data labels to show proportion sizes. As the manufacture year increases, so does the proportion of higher safety-rated vehicles. Of vehicles manufactured from 2016 to 2021 in the collected sample, 95.9% had an ANCAP 5-star rating.

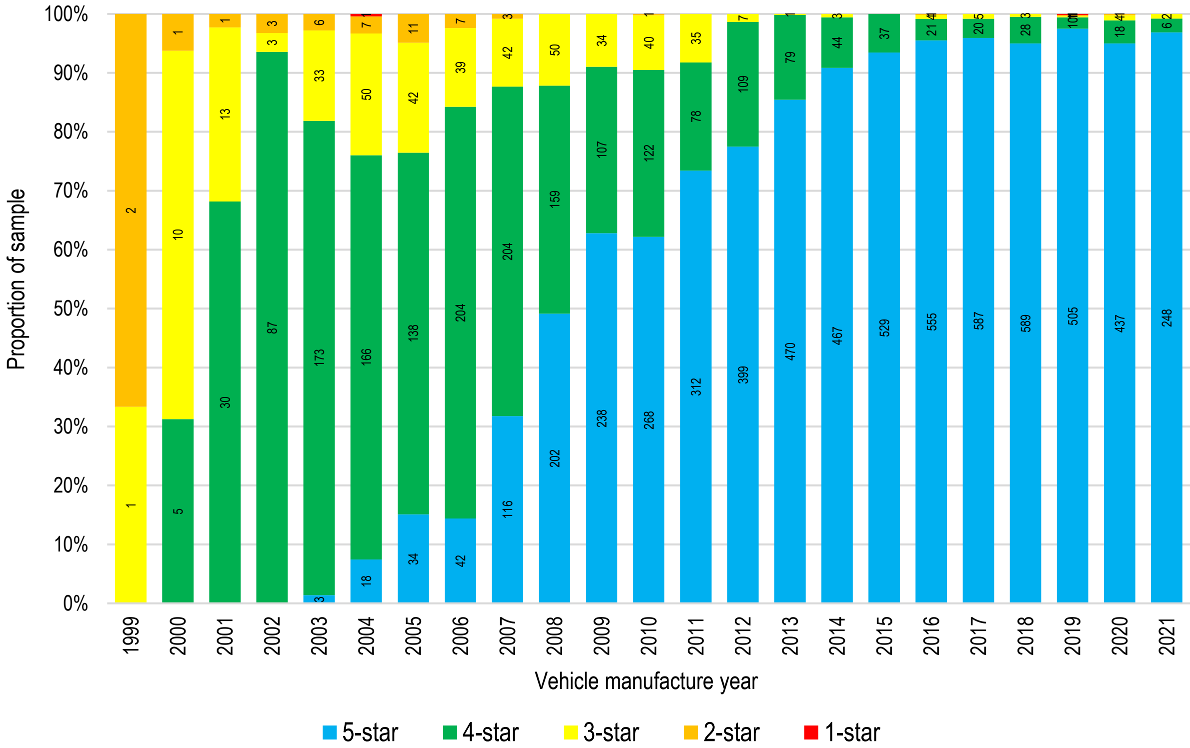

Figure 3.3
ANCAP star rating proportions for each manufacture year of vehicles in collected sample

Another method of analysing the ANCAP star rating prevalence is using the Local Government Area (LGA) boundaries. Figure 3.4 shows a map of each LGA where number plates of vehicles were collected and shows the proportion of 5-star vehicles in each LGA. Note that for some LGAs, the number of vehicles collected was very small, which significantly affected the proportion rates.

A similar map style analysis could be replicated for any safety technology.

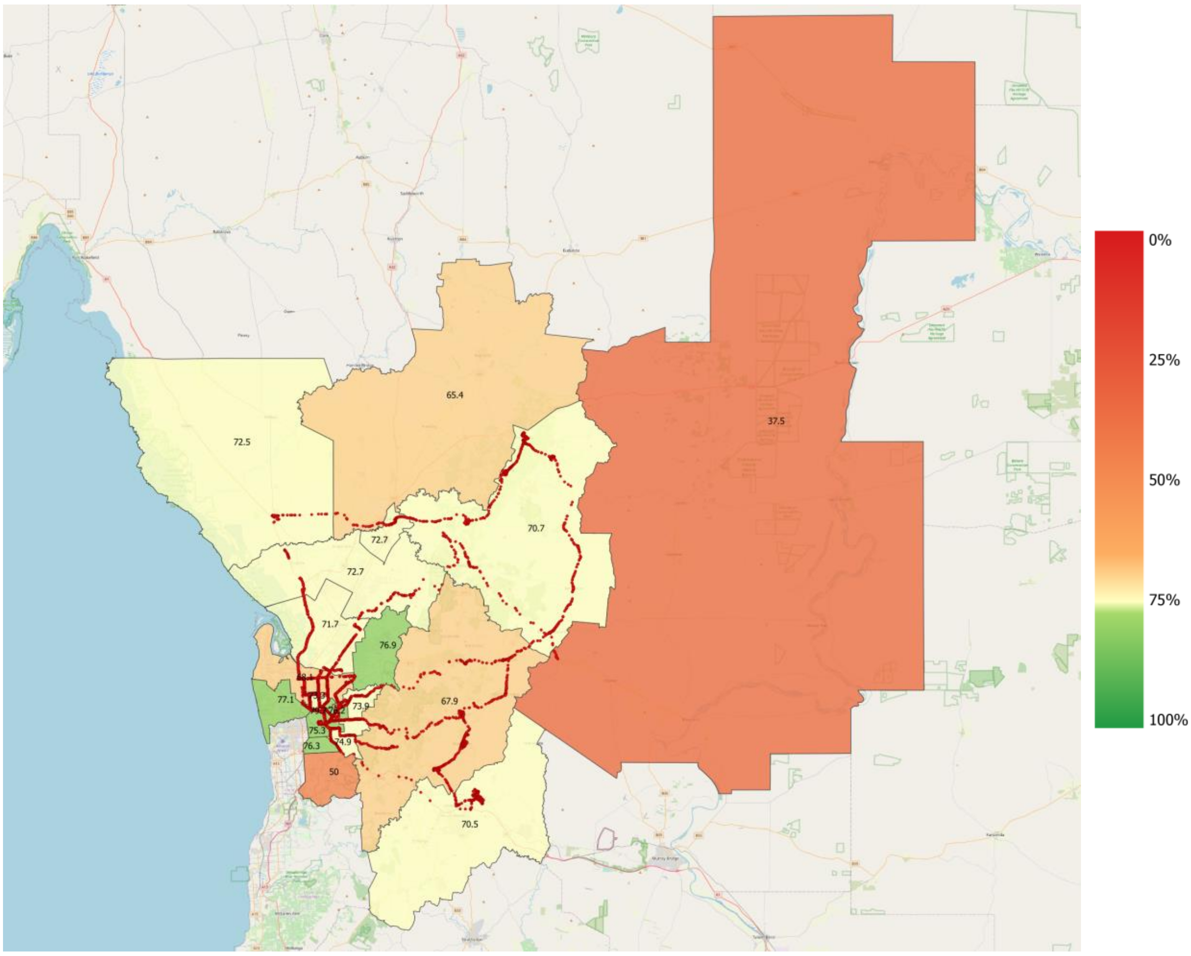

Figure 3.4
ANCAP star rating proportions (5-star vehicles) for each Local Government Area in collected sample

3.3 Safety technologies

A range of safety technologies are recorded by ANCAP, as outlined in Section 2.3, from seatbelt technologies through to advanced safety features such as Autonomous Emergency Braking (AEB) and fatigue detection. The prevalence of major vehicle technologies in metropolitan and rural zones are listed in Table 3.3. The uptake of these technologies for each vehicle manufacture year are included in Appendix A.

Table 3.3
Safety technologies equipped in collected sample of vehicles, split by metropolitan and rural regions

Vehicle technology	Standard		Optional/ higher variant only		Not equipped		Unknown	
	Metro	Rural	Metro	Rural	Metro	Rural	Metro	Rural
Three-point seatbelts for all forward-facing seats[1]	91.8%	91.8%	0.0%	0.0%	3.9%	3.7%	4.4%	4.5%
Seatbelt pretensioners (front)	97.4%	97.9%	0.9%	0.3%	0.4%	0.4%	1.3%	1.4%
Intelligent seatbelt reminder (driver)	81.6%	82.5%	0.2%	0.2%	12.1%	11.4%	6.1%	6.0%
Intelligent seatbelt reminder (front passenger)	73.2%	74.3%	0.4%	0.4%	19.8%	18.8%	6.6%	6.5%
Airbag – Frontal (driver)	99.0%	99.5%	0.9%	0.5%	0.0%	0.0%	-	-
Airbag – Frontal (front passenger)	95.6%	96.4%	4.3%	3.6%	0.0%	0.0%	-	-
Airbag – Sides (front row)	68.4%	69.2%	20.5%	19.6%	11.1%	11.2%	-	-
Airbag – Curtains (front row)	68.9%	70.7%	19.2%	18.7%	12.0%	10.6%	-	-
Airbag – Knee (driver)	32.2%	31.2%	2.4%	2.6%	65.4%	66.2%	-	-
Anti-lock Braking System (ABS)	88.6%	89.8%	7.4%	6.1%	4.0%	4.1%	-	-
Electronic Brakeforce Distribution (EBD)	80.6%	82.1%	2.5%	2.7%	1.3%	0.9%	15.6%	14.3%
Emergency Brake Assist (EBA)	65.0%	66.1%	1.3%	1.1%	2.5%	3.1%	31.2%	29.7%
AEB – City	12.5%	12.7%	19.3%	19.5%	14.9%	17.1%	53.3%	50.7%
AEB – Interurban	11.0%	11.3%	8.1%	8.5%	16.7%	18.7%	64.2%	61.6%
AEB – Vulnerable road users	9.1%	8.7%	4.7%	4.9%	22.0%	27.0%	64.2%	61.6%
AEB – Backover	0.1%	0.0%	0.0%	0.0%	1.5%	1.7%	98.4%	98.3%
AEB – Junction assist	0.5%	0.8%	0.0%	0.0%	0.9%	0.7%	98.6%	98.5%
Headlights – Daytime running	24.1%	25.0%	8.9%	9.9%	2.3%	2.2%	64.7%	62.9%
Headlights – Automatic	18.9%	21.6%	13.3%	11.9%	0.7%	0.9%	67.1%	65.6%
Headlights – Adaptive	2.2%	2.8%	4.8%	5.0%	5.8%	5.7%	87.2%	86.6%
Electronic Stability Control (ESC)	72.4%	73.7%	8.0%	7.8%	5.9%	5.6%	13.7%	12.9%
Fatigue detection	6.0%	6.0%	6.2%	6.4%	2.6%	2.7%	85.3%	84.9%
Fatigue reminder	7.2%	7.4%	0.8%	1.0%	4.8%	5.0%	87.3%	86.6%
Forward collision warning	7.5%	7.3%	3.8%	4.0%	1.0%	1.1%	87.7%	87.5%
Lane Departure Warning (LDW)	8.0%	8.5%	21.7%	22.3%	13.5%	15.0%	56.8%	54.1%
Lane Keep Assist (LKA)	6.8%	7.1%	2.5%	2.7%	16.3%	18.9%	74.4%	71.3%
Speed assistance – auto / intelligent speed limiter	4.2%	4.1%	0.5%	0.7%	17.9%	19.8%	77.4%	75.4%
Speed assistance – speed sign recognition & warning	5.0%	4.8%	1.4%	0.7%	15.1%	17.9%	78.5%	76.6%
Blind spot monitoring	6.0%	6.4%	16.2%	16.9%	5.0%	5.5%	72.7%	71.3%

[1] Note: Some centre-rear seats may have two-point waist seatbelts, not three-point seatbelts

Some observations of interest were noted based on the collected sample:

- There seemed to be minimal difference between the prevalence of safety technologies in vehicles located in metropolitan areas compared to rural areas.
- Intelligent seatbelt reminders were more prevalent for drivers than for front passengers in the collected sample.
- A very large majority of vehicles collected and matched to ANCAP data had frontal airbags for both the driver and front passenger.
- Anti-lock Braking Systems (ABS) were more prevalent than Electronic Brakeforce Distribution (EBD) and Emergency Brake Assist (EBA) technologies.
- The most common AEB technology, AEB – City was installed in about an eighth of the collected sample.
- For vehicles manufactured in 2021, at least 60% (possibly up to 90%) were equipped with AEB – City, AEB – Interurban and/or AEB – Vulnerable road users technology (shown in Appendix A).

- Of vehicles produced from 2014 onwards, at least 97.9% (potentially greater) of vehicles were installed with ESC (shown in Appendix A).
- Fatigue detection and fatigue reminder systems were only installed in a small portion of the vehicle fleet.
- Fatigue detection is more prevalent in newer vehicles and is equipped in at least 40% of the 2021 vehicles (shown in Appendix A).
- Lane Departure Warning (LDW) technology had much higher proportions of being an optional technology for the vehicle sample compared to Lane Keep Assist (LKA) technology.

4 Discussion

A method to determine the prevalence of vehicle safety technologies throughout a region was devised by attaching Automatic Number Plate Recognition (ANPR) cameras to a vehicle, linking captured number plates to registration data, then linking registration data to vehicle-specific ANCAP ratings data. Multiple vehicle safety technologies were able to be explored, comparing the prevalence of each technology in metropolitan and rural areas.

Based on the results obtained from this sample, there was minimal difference between the prevalence of safety technologies of vehicles in metropolitan areas compared to rural areas.

Some limitations were identified in this pilot study:

- 'Rural' zones were based on the ABS Remoteness Area Map, the boundary of metropolitan areas was enclosed by the 'Inner Regional Australia' zone. It could be argued that vehicles captured in the 'Inner Regional Australia' zone were on common highways or were not far enough away from the city to be classified as 'rural'. For any future studies, the levels of rural classifications could take alternative characteristics into consideration. Future studies could also venture farther into higher levels of ruralness.
- ANCAP does not rate vehicles other than passenger vehicles. Therefore, motorcycles, heavy vehicles and other vehicles have been excluded from the analysis.
- ANCAP did not rate any passenger vehicles that were manufactured before 1999. Of the passenger vehicles manufactured after 1999, ANCAP rated the majority, but not all. Vehicles that had not been rated by ANCAP were excluded from the analysis where necessary.
- ANCAP data (star ratings and safety technologies) was generously provided in the format of a range of years for each vehicle make and model. For example, the 2011 Toyota Hiace was rated officially, and retained the same scores and safety technologies until 2019, when the newest model was re-rated. Vehicles built from 2012 to 2018, were attributed the same vehicle technologies as the 2011 tested vehicle, even if they were upgraded in that time.
- Many of the vehicle technologies were coded as 'Unknown' in the ANCAP data, which may indicate that at the time of testing the technology was not yet typically installed in vehicles or was not tested for by ANCAP. It may be reasonable to assume that safety technologies recorded as 'Unknown' were not equipped in those vehicles for some technologies.

Alternative methods

In the data collection phase, the hired ANPR camera system was reliable in detecting number plates from the video footage and securely uploading the results to a database accessible in real-time. Other companies offer similar services, but there are also cameras with integrated ANPR software available for an outright purchase. For a longer-term study, an outright purchase may be more feasible and affordable than the hiring of a system. The cost for a single camera equipped with ANPR software suitable for in-vehicle data collection ranges from $3,500+. ANPR software could also be linked to existing traffic monitoring cameras, for example, point-to-point cameras.

As an alternative to the current data matching phase, Redbook (a company that provides vehicle details including vehicle safety features) offers a "Rego to Redbook ID" service which links registration plates of vehicles to an exact Redbook vehicle (make, model, year and trim specified). With the trim of a vehicle specified, Redbook provides a list of the standard equipment and optional equipment (optional equipment is rarely a safety technology). Using the Redbook service would almost eliminate ANCAP's safety technology statuses of 'Optional/ higher variant only' and 'Unknown'. Redbook also has the ability to identify safety technologies equipped in motorcycles, but would be unable to provide data for vehicles other than passenger vehicles (e.g., trucks, buses, etc.). The cost of RedBook's services include a once off $2,500 set up fee, a $1,500 per month connection fee and a $0.22 lookup fee per vehicle.

Future works

This pilot study was very successful in completing its aim of trialling a method to determine the prevalence of vehicle safety technologies in the active vehicle fleet. It would be of great benefit to duplicate this study on a larger scale. Registration data alone only provides an idea of what vehicles are being driven on South Australia's roads, whereas the use of number plate recognition devices allow for an accurate representation of the active South Australian fleet. Knowledge of the prevalence of each vehicle technology in the fleet should assist with decision making regarding priorities such as infrastructure upgrades and driver education schemes.

A large-scale study could include multiple cameras (including fixed and in-vehicle) positioned and travelling throughout South Australia collecting vehicle number plates of the active fleet and associating their respective safety technologies. The Safe-T-Cam network currently deployed throughout South Australia and Point-to-Point speed cameras are good examples of existing systems equipped with ANPR technology that could be utilised. An analysis could then provide insights on where vehicles are more likely to have particular technologies, and where efforts could be directed to encourage a higher uptake of certain safety technologies. The study could span over any length of time and be conducted throughout any area, from a single road point up to the whole of South Australia.

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Ponte G, Hutchinson TP, Kloeden CN (2022). An examination of potential exposure measures for vehicle safety technologies in South Australia (CASR174), Centre for Automotive Safety Research, Adelaide.

Appendix A – Uptake of vehicle safety technologies by year of vehicle manufacture

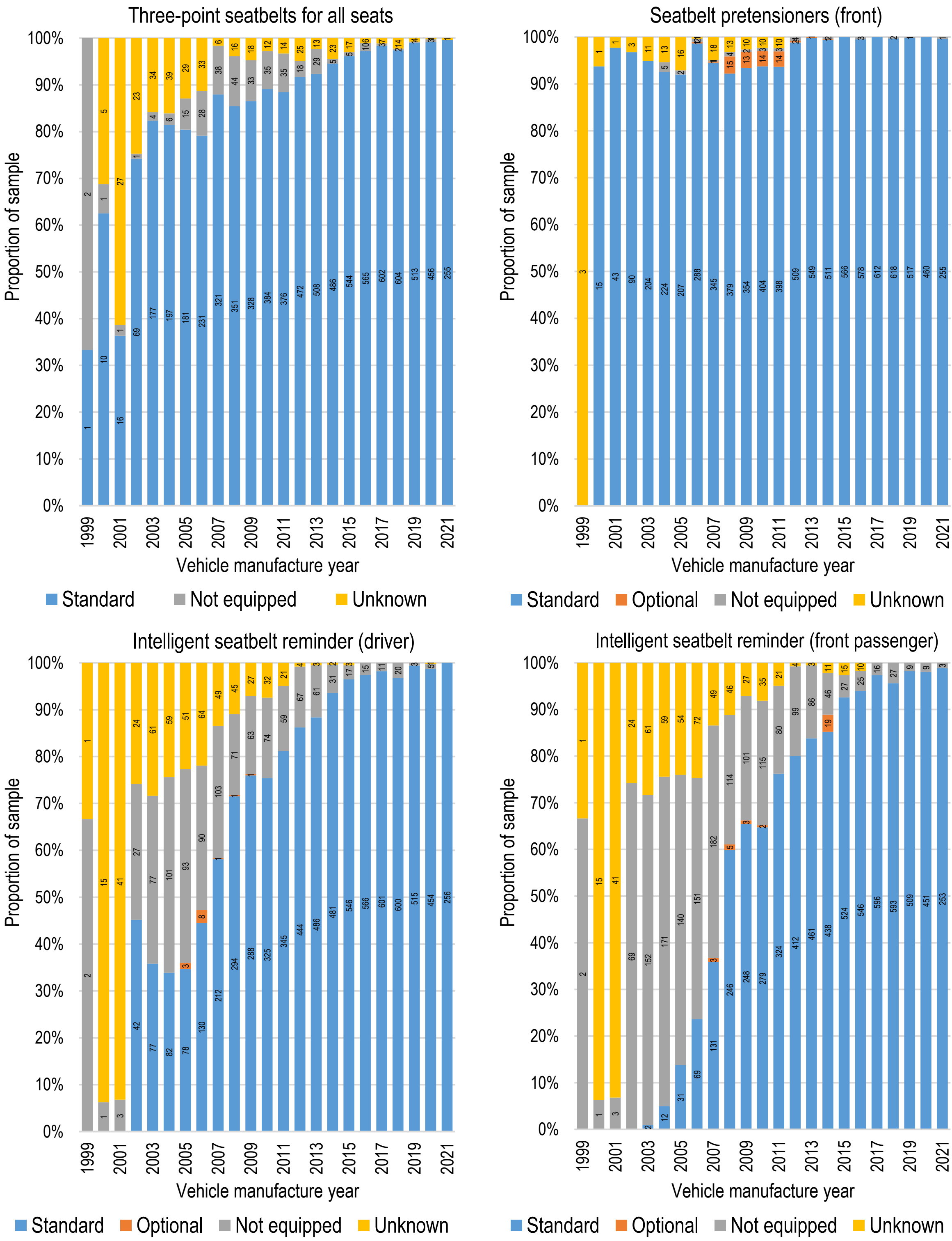

Figure A.1
Yearly trends for seatbelt technologies of collected sample

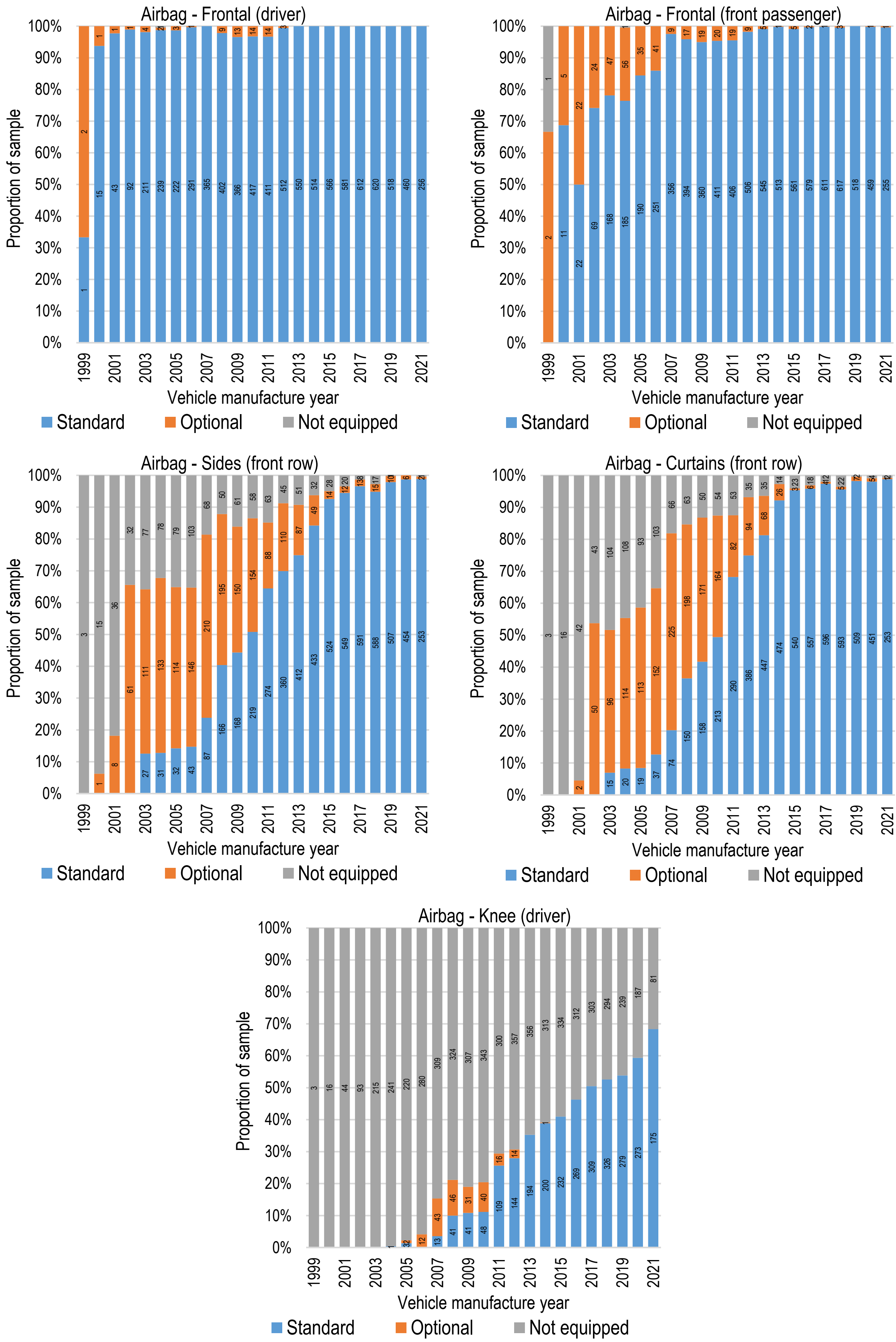

Figure A.2
Yearly trends for airbag technologies of collected sample

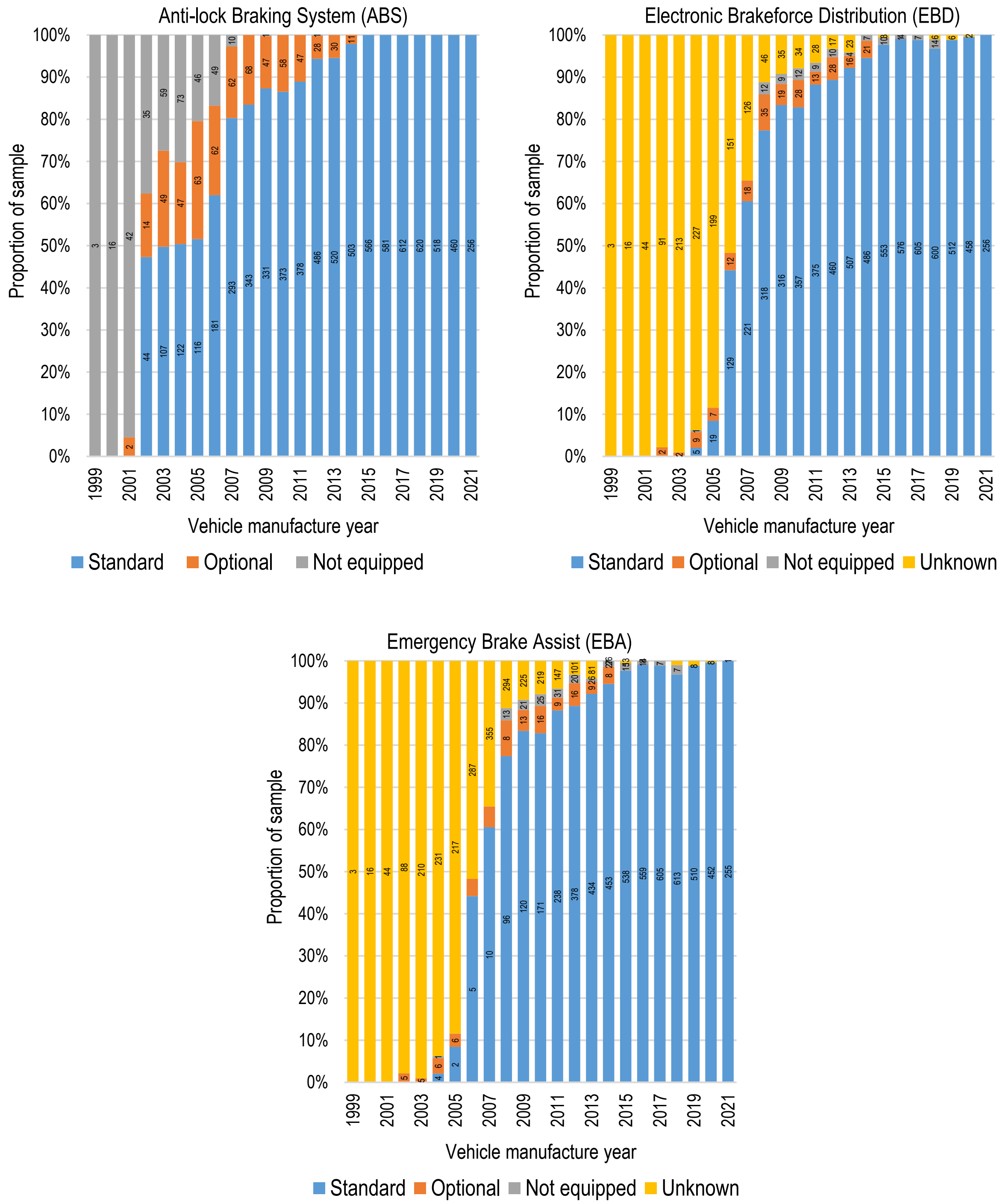

Figure A.3
Yearly trends for braking technologies of collected sample

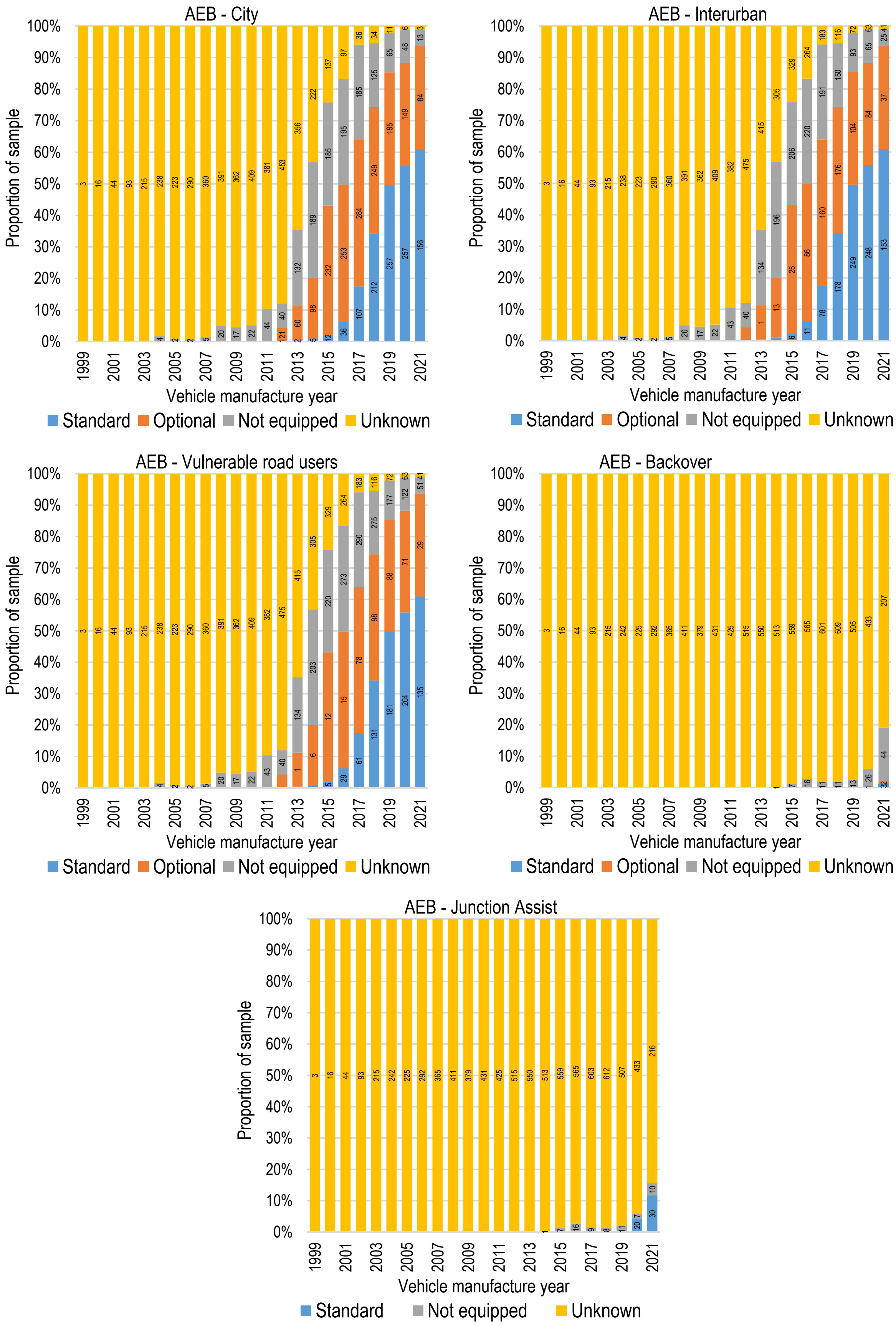

Figure A.4
Yearly trends for Autonomous Emergency Braking (AEB) technologies of collected sample

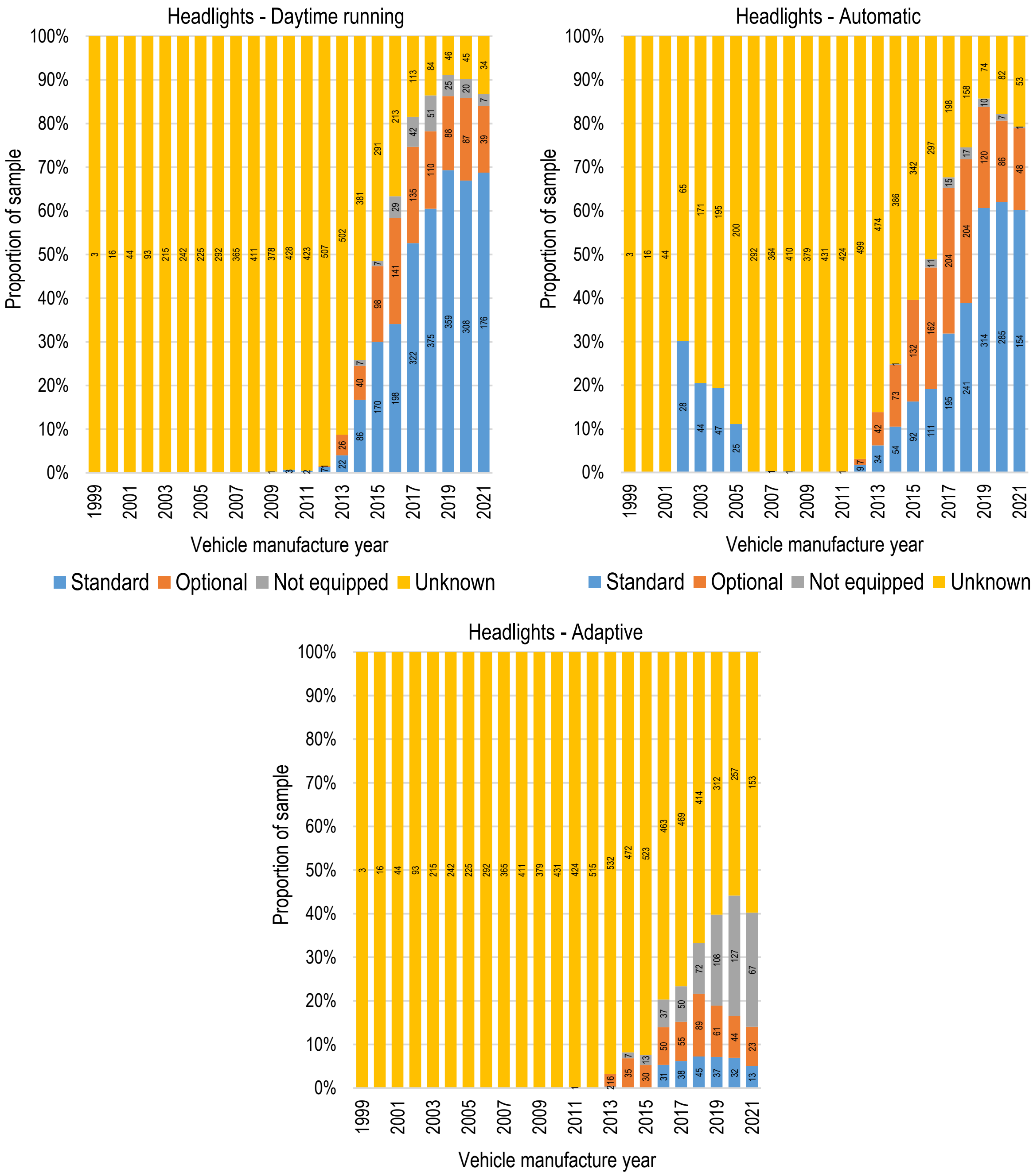

Figure A.5
Yearly trends for headlight technologies of collected sample

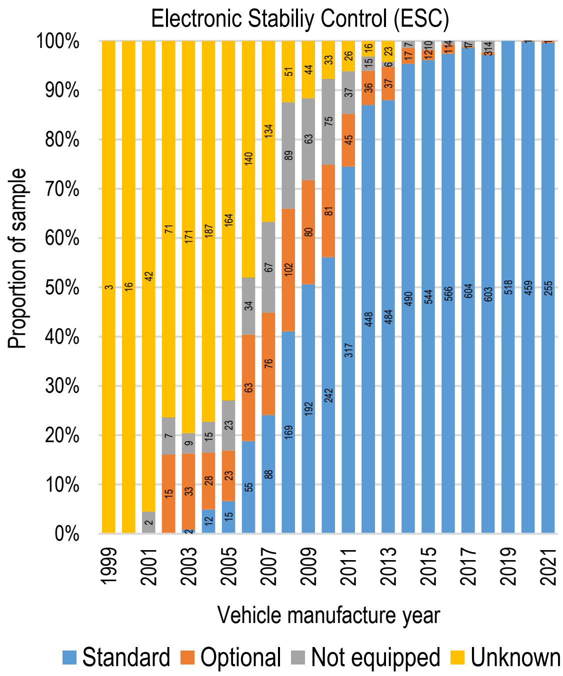

Figure 0.6
Yearly trends for Electronic Stability Control (ESC) of collected sample

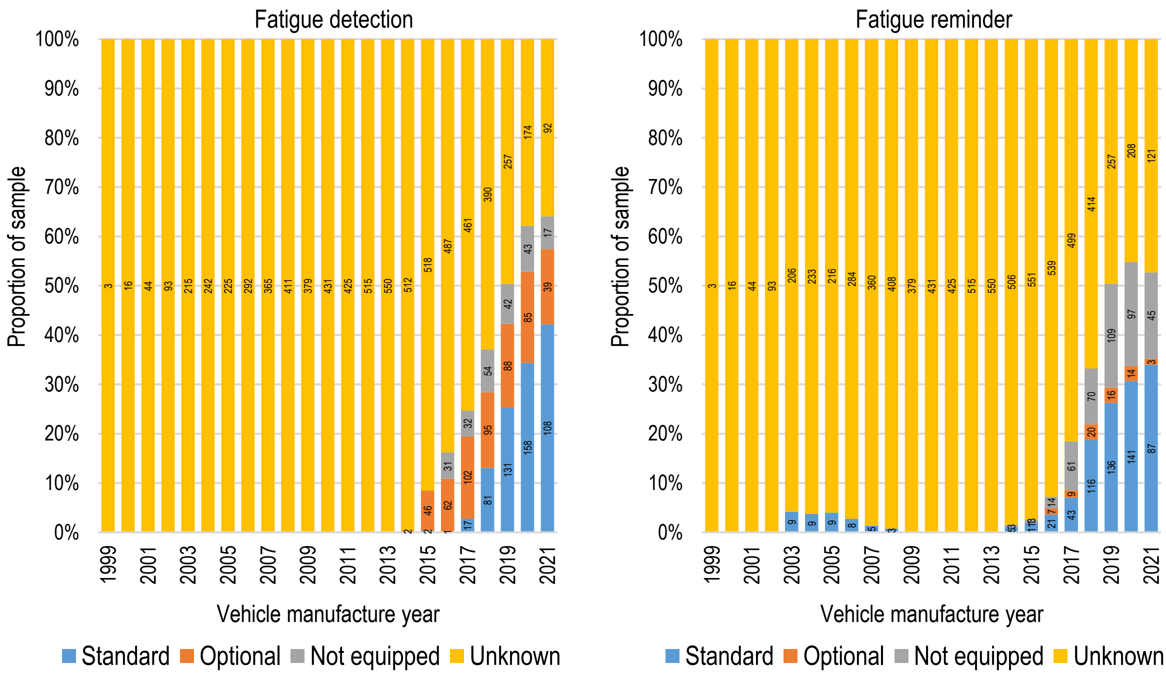

Figure A.7
Yearly trends for fatigue technologies of collected sample

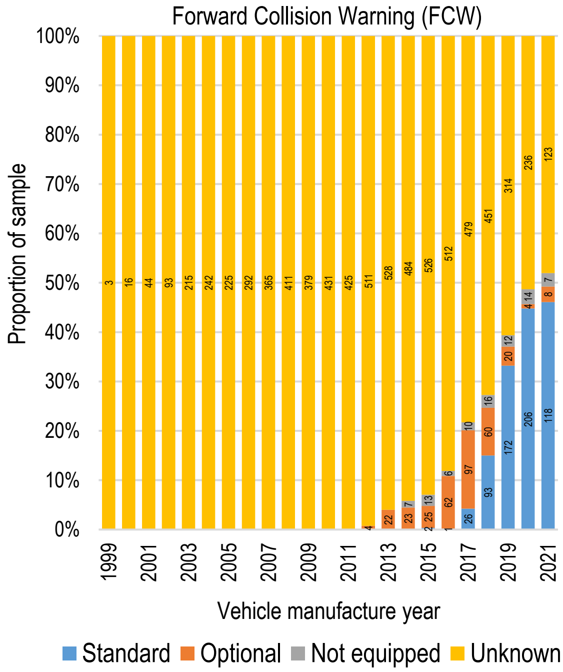

Figure A.8
Yearly trends for Forward Collision Warning (FCW) technology of collected sample

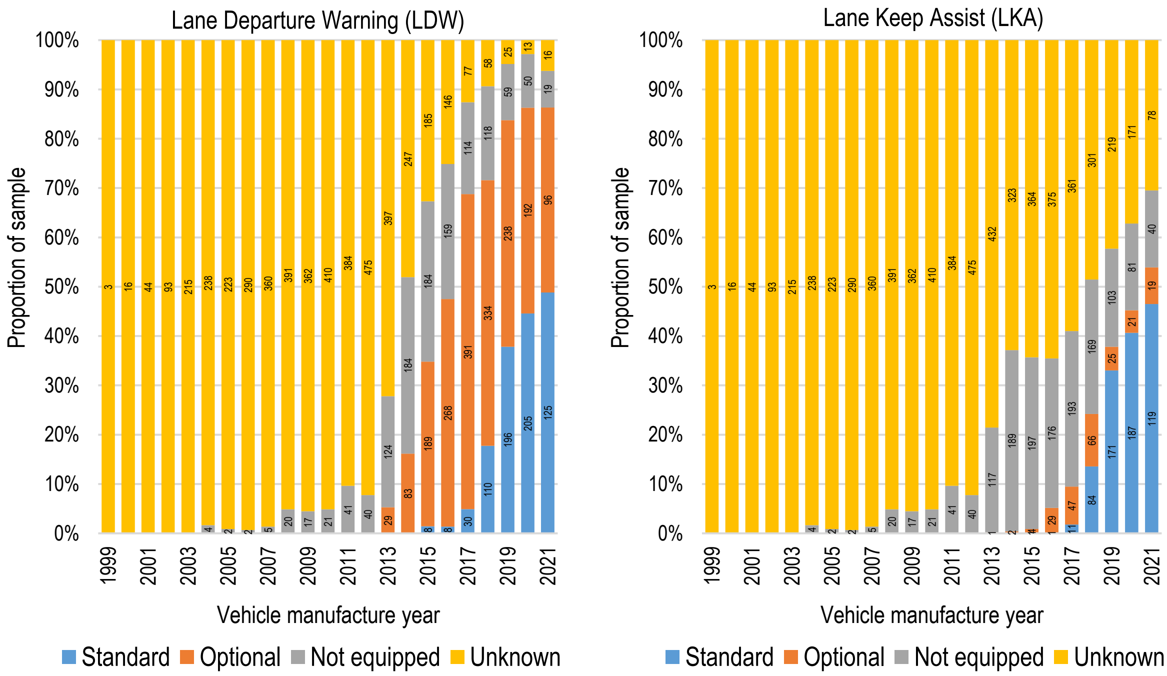

Figure A.9
Yearly trends for Lane Support Systems (LSS) technologies of collected sample

Figure A.10
Yearly trends for speed assistance technologies of collected sample

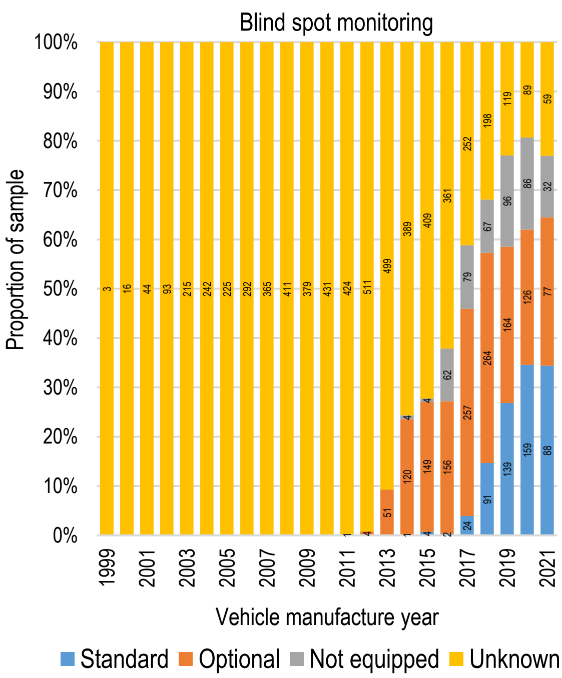

Figure A.11
Yearly trends for blind spot monitoring technologies of collected sample