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ACCIDENT RESEARCH CENTRE

Event Data Recorders: Establishment of a benefits and cost implications framework for use in a regulatory impact assessment

RESEARCH AND ANALYSIS ON THE COSTS AND BENEFITS FOR THE MANDATORY INSTALLATION OF EDRs IN ROAD VEHICLES AT FIRST SUPPLY TO THE AUSTRALIAN MARKET

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FOREWORD

Through sponsorship and support from the Vehicle Safety Standards division of the Department of Infrastructure, Transport, Regional Development, Communications and Arts (DITRDCA), the Monash University Accident Research Centre (MUARC) set out to examine the likely benefits and costs of a mandate at first supply of Event Data Recorder (EDR) systems fitted to Category M and Category N vehicles.

To this end this report seeks to:

a) Establish a framework for use in a future regulatory impact assessment.

b) Define the anticipated benefits of a mandate of EDR technology.

c) Provide financial estimates of benefits and costs associated with EDR fitment insofar as possible.

The project method included a desktop review of available literature on the use-case for EDR data, as well as consultation with forensic experts, including police.

The findings of the research are intended to be used as inputs to any future regulatory analysis of an EDR mandate under the Australian Design Rule (ADR) system.

Keywords: Event Data Recorder (EDR), regulation, benefits, crash investigation, data privacy, framework, benefit cost analysis, Australian Design Rules, United Nations Regulation.

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ACKNOWLEDGEMENT OF COUNTRY

Monash University acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Owners of our land. At Monash University campuses and sites in Melbourne, we acknowledge the people of the Kulin Nations and pay respect to the Elders and Traditional Owners of the land on which our Australian campuses stand.

Monash University is committed to fostering a society that recognises, respects, and includes Australia's Indigenous Peoples, cultures and knowledges, and works towards addressing the legacies of the past.

For further information, see the [Monash Aboriginal and Torres Strait Islander Framework 2019-2030]

Birrarung (Yarra) river

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We also thank a number of technical specialists who participated in detailed interviews on the *use case* of EDRs and shared their experience from a forensic expert witness perspective, a policing perspective, and an academic research perspective. These experts included:

- Detective Leading Senior Constable **Mick Hardiman,** Collision Reconstruction and Mechanical Investigation Unit, Crime Scene Group I, Forensic Services Department, Victoria Police.
- **Tandy Pok Arundell**, Allied Forensic Group (AFG).

A number of other experts provided various insights into the use of Event Data Recorders however are not publicly acknowledged at their request.

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EXECUTIVE SUMMARY

CONTEXT

Event Data Recorders (EDR), colloquially known as 'black box' recorders, store vehicle and driver-input data in the time leading up to a crash. This data includes, for instance, seat belt use, travel speed, braking and steering. The EDR also stores data relating to the crash itself, including change of vehicle velocity and other crash-based metrics. Data is collected dynamically on a memory card but locked once a crash, or other pre-defined 'event trigger' (e.g., hard braking) event occurs. In passenger vehicles the EDR is implemented as part of the Airbag Control Module (ACM), while in heavy vehicles EDR data (HVEDR) is obtained through on-board engine management diagnostic systems. Specialist equipment is required to access the EDR data, which is used in a variety of ways (i.e., use cases) outside the vehicle. The data collected by the EDR also has important functions within vehicles.

EDRs have been subject of regulation in the United States (US) since 2012, with rulemaking having commenced as early as 2004. Whilst the US Regulation (49 CFR Part 563) does not mandate the fitment of EDRs, it does mandate the data elements where an EDR is fitted by manufacturers and has important requirements pertaining to data access. The US Government, through the National Highway Traffic Safety Administration (NHTSA), specifically pointed to the value of EDR data in facilitating crash investigations and the conduct of academic research, as well as for use in improving vehicle safety when developing the regulation. Due to the universal availability of EDR data in the United States, a significant amount of research has been conducted using EDR data.

With the passage of the *General Safety Regulation (GSR-2)* (EU) 2019/2144 (27 November 2019), the European Union (Parliament) mandated the fitment of EDRs to passenger vehicles and heavy vehicles. Delegated Regulations were then passed to bring this mandate into practical effect. Throughout the EU the fitment of EDRs was made mandatory from 6 July 2022 for new light passenger vehicle models and from 7 July 2024 for all new passenger vehicles sold. The fitment of EDRs was made mandatory for new heavy vehicle models from January 7, 2026 (new types) and for all new heavy vehicles sold from January 7, 2029. The EU adopted UN Regulation No 160 for passenger vehicles (M category) and UN R 169 for heavy duty vehicles (N category). Notably, through its Delegated Regulation the EU included provisions that required vehicle manufacturers to provide all necessary information and means to facilitate the download of data from the EDR.

Both the UN R 160 and UN R 169 were developed by the EDR/DSSAD working group within Working Party 29 of the UN ECE. These regulations were implemented as UN R 160 (passenger vehicles) [30 September 2021] and UN R 169 (heavy vehicles) [19 June 2024], respectively. Consequently, these UN Regulations must now be considered for implementation in Countries that are signatories to various United Nations *Agreements,* including Australia. It is within this context that the Australian Government formulated an *Issues Paper*[1] with respect to Event Data Recorders. This *Issues Paper* highlighted questions pertaining to the alignment of any future ADR with the UN and/or US Regulation(s) with respect to included data elements, ownership and retrieval of EDR data, access to and storage of EDR data, factors impacting public acceptance of EDR technology, and inputs for a regulatory impact assessment. The benefits of EDR data to research was also noted.

With the above in mind, this project was initiated to provide further insight into the range of issues identified by the Australian Government in the EDR *Issues Paper* with respect to potentially mandating EDR technology at first supply for vehicles into Australia. This included undertaking an examination of the likely benefits of such a mandate and following this, the development of a benefits framework that can be used in any future EDR impact assessment analysis.

OBJECTIVES

The Monash University Accident Research Centre (MUARC) was commissioned by the Vehicle Safety Standards division of the Department of Infrastructure, Transport, Regional Development, Communications and Arts (DITRDCA) to examine the likely benefits and costs of a mandate at first supply of Event Data Recorder (EDR) systems fitted to Category M and Category N vehicles.

[1] Australian Government – Department of Infrastructure, Transport, Regional Development, Communication and the Arts. (2022) Event Data Recorders: Issues Paper. (October 2022).

To fulfil this objective, this *Report* seeks to:

a) Establish a framework for use in a future regulatory impact assessment and provide inputs for use in the formulation of a *Regulatory Impact Statement (RIS)*.

b) Define the anticipated benefits of a mandate of EDR technology.

c) Provide financial estimates of benefits and costs associated with EDR fitment insofar as possible.

To achieve the above, this *Report* provides a description of EDR technology, current regulations and standards, including those ratified by the United States (US), the United Nations (UN), and the European Union (EU). Provisions concerning EDR data ownership, privacy, and data access and retrieval are also outlined, with reference made to relevant regulations, legislation and court judgements. Doing so provides a basis for not only understanding the nature of EDR regulations themselves but provides a basis for understanding how EDR data can be accessed for use.

To inform a future regulatory impact assessment of an EDR mandate, the *Report* also documents the process of EDR data retrieval, inclusive of equipment required and associated equipment costs. As the focus of this *Report* is on Australia, coverage, or download support, of Australian vehicles by currently commercially available EDR data retrieval systems are examined using crash data and vehicle sales data. Crash data by vehicle type and vehicle age is also presented; this can be used as an input to the calculation of benefit-cost ratios in a future impact assessment analysis should such analysis be conducted.

A key part of the *Report* is the identification of use cases for EDR data. This provides the basis of establishing a benefits framework for application in a future impact assessment of a mandate of EDR technology into vehicles at first supply to the Australian market.

FINDINGS IN RELATION TO EDR TECHNOLOGY, REGULATIONS, AND ACCESSIBILITY

The *Report* examines the following topics.

- The purpose of EDRs, their function, the type of data captured (e.g., speed, braking), and implementation into vehicles.
- The purpose, applicability, and requirements concerning EDRs as specified by EDR Regulations, including the United States Regulation 49 CFR Part 563, and UN R 160 (EDR for passenger vehicles) and UN R 169 (EDR for heavy duty vehicles) as adopted by the European Union (EU). EDR regulations enacted, or under development by other Countries including Japan, Korea, China, the Russian Federation, and India are also noted. EDR Standards, as published by the *Society of Automobile Engineers (SAE)* were also documented.
- Regulatory requirements that force manufacturers to provide the means to access readable and interpretable EDR data.
- Regulatory requirements and legislation concerning EDR data ownership, privacy, and access consent requirements. In short, select jurisdictions (including the United States) have adopted explicit provisions that assert ownership rights of EDR data to the vehicle owner, and that vehicle owner consent to access the EDR data – with exceptions for law enforcement – is required. No such legislative provisions that explicitly mention EDR ownership and access consent exist in Australia. Considerations relating to accessing EDR data in Australia are noted.
- Technical requirements and equipment costs to access passenger vehicle EDR data using the commercially available Bosch Crash Data Retrieval (CDR) system and the Tesla and Hyundai (including Kia / Genesis) EDR data retrieval systems. A description of how EDR data is accessed from heavy vehicles is also described. Using this information combined with crash data and new vehicle sales data, this *Report* estimates that commercially available EDR CDR systems supports the download of EDR data from 30% of 2000 and later Model Year (MY) vehicles involved in police reported crashes and 57% of all new vehicles sold in Australia in 2024.

With an understanding of relevant EDR regulations, implementation considerations, and vehicle coverage, the basis for defining the use cases of EDR data, and hence benefits, was set.

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ESTABLISHMENT OF A BENEFITS FRAMEWORK

The primary objective of this *Report* was the establishment of a benefits framework that could be used in the conduct of a regulatory impact assessment for the mandate of EDRs fitted to vehicles sold in Australia. To this end the full range of uses cases, as understood by the *Report* authors and consulted experts and represented in the research and applied literature, were defined.

While it has been observed that EDR data was originally intended to be used by vehicle manufacturers as an input to examine the crash performance of their vehicles and to optimise the performance of vehicle safety systems, the value of EDR data for crash investigations conducted by police and the insurance industry was quickly recognised, as was the use of EDR data in facilitating academic research that was not previously possible.

Table E.1 provides the EDR benefits framework developed in the course of this project. It is anticipated that this framework could be used in any future regulatory impact assessment of an EDR mandate in Australia.

For each use case benefits in financial terms are derived where possible; in the absence of direct financial benefits being estimated, an explanation as to how the benefits regarding the use of EDR data can be expressed is provided. Dependencies on the access to and the use of EDR data are also specified for each use case. Considerations regarding the cost of implementing an EDR mandate are also described.

TABLE E.1 EDR BENEFITS FRAMEWORK: SUMMARY OF USE-CASES AND ASSOCIATED BENEFITS THAT CAN BE DERIVED FROM THE USE OF EDR DATA.

BENEFITS OF USE
EDR data as an enabler of academic research
• By providing objective pre-crash and crash data metrics, EDR data is an enabler of academic research. EDR data gives researchers insight into pre-crash road user behaviour (i.e., speed, braking, steering), crash severity (i.e., impact speed, delta-V), the performance of vehicle passive safety systems (e.g., airbags), and the function of vehicle Advanced Driver Assistance Systems (ADAS) immediately prior to, and during crashes. • In the absence of EDR data, researchers must use multiple data points to derive estimates of relevant parameters (e.g., seat belt use, pre-crash travel speed).
• Research topics facilitated or enabled by EDR data include: o Estimation of injury probability curves by impact direction and impact speed, for use in speed limit setting and vehicle safety countermeasure design. o Ensuring the appropriate activation of automatic crash notification systems. This ensures emergency services are contacted when required and prevents the over triage of uninjured road users. o Establishing the proportion of crashes where exceeding the speed limit was a contributing factor, for use in speed limit setting, developing enforcement programs, and estimating the benefits of Intelligent Speed Assist (ISA) technology. o Establishing the crash risk associated with travel speed in case-control speed crash risk studies, for use in developing enforcement programs and quantifying the benefit of speed limit compliance. o Establishing the proportion of crashes where seat belts are not used. This knowledge can then be used to develop enforcement programs, develop seat belt warning systems, and appropriate regulations, and to optimise airbag performance. o As an input to understanding crash and injury causation, and the validation of contributing factors. This insight can inform road safety policy and programs. o Estimating crash severity for motorcyclists by accessing the EDR data of the striking vehicle. This data is invaluable as there is little objective data of the impact speed and crash severity for powered two-wheelers (PTW). This knowledge can be used to improve motorcycle design and motorcyclist protective equipment. o Validation of crash reconstruction processes, which in turn are used to estimate key pre-crash and crash metrics. This data can then be used as the basis for 'what-if' scenarios (e.g., lower speed, earlier braking, effect of ADAS technology). Along with understanding pre-crash manoeuvres, these outputs (including EDR data) can inform the development of new active safety systems, NCAP protocols and regulations. o EDR data points (e.g., impact speed, delta-V) can also be used to statistically adjust for crash severity when i.) assessing the real-world safety performance of vehicles ii.) when evaluating the benefits of vehicle regulations, including for instance Australian Design Rules, and iii) examining differences in injury outcomes across crash (e.g., impact direction) and occupant parameters (e.g., age, sex).

Quantification of financial benefits
• Unable to quantify the benefits of research using EDR data in financial terms due to the difficulty of directly linking research findings to road safety policy and regulations, other than to state that research findings inform the development of road safety strategies and action plans (e.g., speed limit settings), as well as vehicle-based passive and active safety systems.
• Benefits best described in qualitative terms of facilitating academic research by being able to address specific research questions with objective data as it relates to vehicle control (e.g., speed, impact speed) and other driver behaviours (e.g., use of seat belts, cruise control) pre-crash. Objective data provides greater confidence in the research findings. Parameters derived from EDR technology can be used directly in analysis or to inform and/or validate computer-based crash reconstruction.
• Time saving benefits associated with computer-based crash reconstruction in an academic research context was estimated to range from 4 – 6 days, translating to a financial saving of between AUD$ 3,863 to AUD$ 5,794 (2024 values).
Dependencies
• There are two dependencies on the use of EDR data for academic research: 1. A crash, or trigger event of sufficient severity, must occur for the EDR data to be locked. 2. The EDR data must be downloaded in an interpretable manner. ▪ In Australia, this *Report* estimates that 30% of crash-involved vehicles manufactured since 2000 have a readable EDR using commercially available crash data retrieval tools, and further, 57% of new car sales in Australia in 2024 have a readable EDR using commercially available crash data retrieval tools. ▪ The costs of Crash Data Retrieval (CDR) equipment can be high. • Researchers must also obtain approval of a Human Research Ethics Committee, or similar regulatory oversight body, for use of EDR data. Consent of the vehicle owner is also required when researchers are directly accessing the EDR data.
EDR data as a mechanism for the design and assessment of passive and active safety performance in vehicles
• Noted in the US EDR Regulation, the use of EDR data by manufacturers to optimise vehicle safety is a critical use case. Manufacturers can source EDR data through their own crash investigation programs and laboratory sled tests; manufacturers can then use this data in computer simulations when designing new vehicles. Manufacturers may also rely on researchers to collect EDR data on their behalf, as well as using findings published in academic research papers and commissioned reports.
• Research topics include: o Optimisation of airbag and seat belt performance. o Optimisation of the passive safety structure of the vehicle. o Optimisation of active safety systems, particularly the timing of automatic braking, and activation of eCALL / Automatic Crash Notification systems. o Validation of computer-based vehicle models and human body models that are used in the design of vehicles.
Quantification of financial benefits
• Unable to quantify the direct benefits of the 'value add' from use of EDR data in the vehicle design process in financial terms. Best stated qualitatively as giving manufacturers access to objective vehicle-based data that is used in the design of vehicles and vehicle safety systems.
Dependencies
• Manufacturers conducting their own research and development (R&D) work have no barriers to EDR data access for work done in-house. • Manufacturers may rely on published academic research to inform their internal work. Alternatively, manufacturers may commission academic researchers to investigate crashes, in which case the dependencies with regard to EDR data access would apply.

EDR as an enabling technology: informing the provision of emergency medical care through automatic crash notification

- The activation of eCALL depends on the dynamic assessment of crash severity and other events detected by vehicle sensors, including hard braking and deceleration. The EDR dynamically captures relevant data points from crash and other vehicle sensors. Using this information an algorithm included in the Airbag Control Unit determines whether a crash or other deceleration trigger is met. Once a trigger event threshold is met, the airbag ignition signal (or other trigger signal) is sent to the eCALL system. At this point, the EDR event data is locked. The automatic call to emergency services, which is the primary function of eCALL, occurs once this trigger activation is received by the fitted eCALL system. For this reason, the Airbag Control Module and the included EDR are an integral part of the eCALL function. Whether the eCALL function has been triggered is recorded by the EDR.
- Note: the fitment of an Airbag Control Unit and included EDR is independent of, and pre-dates, the fitment of eCALL systems.

Quantification of financial benefits

- The benefits associated with eCALL can be quantified and can in part be attributed to the EDR.
- Based on in-depth crash investigation data, MUARC estimated that eCALL would have been of direct benefit to 5.5% of serious injury crashes by ensuring more rapid emergency care. With regard to preventing fatalities, in 2008 MUARC estimated that eCALL would result in 104 fewer fatalities on Australian roads per annum, with this being cost-beneficial. CASR estimated that Automatic Crash Notification (ACN) would result in between 2.2% to 4.4% fewer fatalities per annum.

Dependencies

- Applicable only in the event of a crash and where eCALL is fitted to a vehicle and is supported by the local emergency management system or facilitated by a third-party service.

EDR data as a facilitator of police forensic investigations

- The investigation of crashes and the prosecution of road users committing wrongdoing is a key responsibility of police. EDR data can play a significant role in the reconstruction of crashes. EDR data provides police with objective pre-crash data across a range of parameters, as well as useful post-crash crash severity information. The objective nature of the EDR data means that the findings of crash reconstructions and police investigations are extremely robust.
- EDR data is used within the *Brief of Evidence* when bringing charges against a road user. Police also use a variety of data points and evidence in addition to the EDR data. EDR data has been accepted by the Courts as being valid.

Quantification of financial benefits

- Time and cost savings for police to investigate crashes by having access to EDR was estimated to be 3 days on average, translating to a saving of $AUD 4,404 per crash investigation.
- Efficiencies gained would also permit police to investigate additional crashes and/or to perform other duties, or to take leave.

Dependencies

- The investigation of crashes is the focus; hence, a crash must occur.
- Police have significant powers to obtain EDR data and do not require the consent of the vehicle driver to do so.

EDR data as a facilitator of motor vehicle insurance forensic investigations

- Insurance companies contract forensic experts to investigate crashes where insurance fraud is suspected. Close to 18,000 motor vehicle insurance claims are investigated in Australia each year.
- Forensic experts can use EDR data to validate the insurance claim, in addition to other available information. EDR data provides investigators with a range of data points that can be used to validate or refute a claim. The objective nature of the data adds weight to its use. The Courts have accepted the use of EDR data by insurance companies.

Quantification of financial benefits

- Following advice from a highly qualified engineer who conducts contract work for the insurance industry, the time saving by having access to EDR data in the investigation of crashes is approximately 5 days; in financial terms this equates to an average, per case saving, of $6,250 (2024).
- The estimated financial saving noted above does not include savings to the insurer from litigation that is avoided, the payout of otherwise fraudulent claims, or Court time.

Dependencies

- Requires a crash to have occurred, an insurance claim to be lodged, with this claim flagged for investigation.
- Under the terms of insurance policies, drivers and vehicle owners must provide all relevant information and consents to the insurance company for the investigation of a claim. This consent, as stipulated in the insurance products *Product Disclosure Statement* covers access to and use of EDR data.

EDR data as a facilitator of third-party injury and statutory compensation schemes decision-making

- Road users injured in crash can make a claim to statutory third-party insurers (i.e., compensation schemes, CTP) for medical and like expenses, loss-of-income, other supports, and lifetime care where appropriate for injuries sustained in crashes. Access to impairment benefits and Common Law resolutions may also apply, depending on the level of impairment, and in the latter case whether an at-fault road user can be identified. Entitlement to select benefits may also be limited depending on the nature of an offence, if any, that led to the crash.
- Third-party compensation schemes have robust systems in place to validate the claims of injured road users.
    - Police reports can be accessed directly. As noted above, Police forensic investigators can use EDR data when conducting these investigations; these investigations seek to establish wrong-doing on the part of a crash-involved person. Use of this information is important for third-party insurers.
    - Third-party insurers may access motor vehicle insurance information, inclusive of any crash investigation conducted (see above).
    - Third-party compensation schemes directly contract the services of forensic investigators in the same way as the motor vehicle insurance sector (see above).

Quantification of financial benefits

- Third-party insurers can be a beneficiary of EDR data first being used by Police or Motor Vehicle Insurers. Use of this information has significant efficiencies for the resolution of claims and the avoidance of fraud. The dollar value of these savings is not quantified here, however.
- Cost savings associated with CTP-initiated crash investigations would mirror that of motor vehicle insurers.

Dependencies

- Requires a crash to have occurred and a CTP claim to be lodged.
- The CTP provider has the right to all information, including EDR data, as a condition of the claim being made.

COSTS ASSOCIATED WITH AN EDR MANDATE AND CONSIDERATIONS

- As a reference point, in 2005 NHTSA estimated a cost of $USD 0.17 cents per vehicle to meet the US Regulation. This low dollar value was due to the fitment rate of 64% of EDRs in vehicles at that time.
- While the fitment of EDRs in passenger vehicles is now universal due to airbag fitment, costs associated with meeting uniform data requirements and other compliance costs need to be derived but are likely to be low. It could be argued that the incremental compliance cost average across all vehicles is similarly negligible in Australia in 2024, and perhaps not more than $3 to $5 per vehicle unit (at its highest) due to the need for a larger SD memory card, software integration, and meeting the costs associated with the type approval process.
- Costs associated with HVEDR are not quantified but are likely to be low given that data systems are universally implemented via heavy vehicle diagnostic systems.
- With future regulations ideally including data ownership, privacy, and access provisions, costs associated with these provisions need to be considered.
- Costs associated with downloading EDR data by academic researchers, police, and insurance, whilst worth noting, do not feed into the regulatory compliance costs and hence, ought not to be included as a cost in the assessment of a mandate. Having said this, estimates of the staff costs associated with the retrieval of EDR data were calculated and were seen to be nominal. Costs were seen to range from $55-$94 for Police and Researchers and $78-$113 for insurance-led forensic investigations; costs vary due to the method used to access EDR data, with this based largely on the extent of vehicle damage post-crash.
- Costs associated with the purchase of crash data retrieval systems (including cables, software licence) are described in the Report.

COMMENT ON THE INTERPRETATION AND USE OF THE FINDINGS

The findings presented in the *Report* are intended to be used to inform a future regulatory impact assessment regarding the mandate of EDR devices for Australian vehicles at first supply. The authors have made every effort to provide objective evidence concerning the current uses of EDR data, as well as likely benefits where they can be defined.

Whether, and how, the findings of this *Report* are used in any future regulatory impact assessment by other experts is beyond the control of the authors, as is the decision to conduct the said regulatory impact assessment. We note that any decision to mandate EDRs rests solely with the Australian Government.

CONCLUSION

Recognising the non-traditional vehicle safety technology that EDR data represents, this *Report* set out to establish a benefits framework for use in a future regulatory impact assessment of an EDR mandate. It is clear from this *Report* that while the technical regulations are complex, as is the implementation of EDRs in vehicles itself, the data provided by EDR technology is of significant value across a range of use cases. Having said this, benefits realisation is first dependent on a crash occurring and then the data being accessed. The status of EDR data being used as an enabler of other activities further complicates the financial quantification of benefits. Having said this, clear time saving benefits emerge in police investigations, with police findings also being of significant of value to CTP insurers in the assessment of claims and attribution of at-fault status for the purpose of common law compensation actions.

The secondary use of police collected EDR data by academic researchers further enhances the value equation of EDR data. While this is the case, it is nonetheless difficult to quantify with any precision the financial benefits that flow from academic research that influences road safety policy or evaluates current vehicle design rules and safety countermeasures. Doing so would require first an assessment of the benefit of the implemented road safety policy in question, after which it would be necessary to attribute a fraction of the decision to implement the initiative to the foundational knowledge established by using the EDR data. With this complexity in mind noting these beneficial use cases in a qualitative manner, as NHTSA did when introducing 49 CFR 563, may be the only alternative.

Finally, implementation of a single common EDR regulation would serve to standardise data points across all vehicles. With learnings drawn from elsewhere, addressing issues of EDR data access and interpretability, as well as data ownership and privacy, is not only feasible but is necessary to overcome the current limitations in making full use of EDR data in Australia. Taking these steps is important to ensure that maximum benefits of EDR data are realised. It is hoped that the findings of this *Report* will serve as useful input to decision making as it relates to implementing mandatory EDR requirements in Australia in the future.

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GLOSSARY AND LIST OF ABBREVIATIONS

ABBREVIATION	FULL DESCRIPTION
§	Section sign (used in legislation)
ABS	Anti-lock Braking Systems
ACC	Adaptive Cruise Control
ACM	Airbag Control Module (see ACU)
ACN / AACN	Automatic Crash Notification / Advanced Automatic Crash Notification
ACU	Airbag Control Unit (see ACM)
ACSF	Automatically commanded steering function
ADAS	Advanced Driver Assistance System
ADR	Australian Design Rule
ADR 69	Australian Design Rule Number 69, Full Frontal Impact Occupant Protection
ADR 72	Australian Design Rule Number 72, Dynamic Side Impact Occupant Protection
ADR 73	Australian Design Rule Number 73, Offset Frontal Impact Occupant Protection
AEB	Auto Emergency Braking
AEBS	Advanced Emergency Braking System
AECC	Accident Emergency Call Components (see ACN)
ANCAP	Australian New Car Assessment Program
ASIC	Australian Securities and Investments Commission
ATD	Anthropomorphic Test Device (human body model used in crash testing)
BCM	Body Control Module
BCR	Benefit-Cost Ratio
CAN	Controller Area Network (includes the CAN protocol)
CASR	Centre for Automotive Safety Research (at The University of Adelaide)
Category M (vehicle)	Passenger vehicle (includes subtypes MA, MB, MC [M1]; MD1, MD2, MD3, MD4 [M2]; ME [M3], under the ADR system
Category N (vehicle)	Goods (commercial) vehicle (includes subtypes NA (N1); NB1 (N2 <12t); NB2 (N2 ≥12t); NC (N3), under the ADR system
CCC	China Compulsory Certification / China Compulsory Certificate (mandatory product certification system)
CDR	Crash Data Retrieval
CFR	Code of Federal Regulations
CNG	Compressed Natural Gas (vehicle fuel)
Cth	Commonwealth (of Australia)
CP	Contracting Party (a country that is a signatory of a UN Agreement)
CSF	Corrective Steering Function
DELTA-V	Vector difference between impact velocity and separation velocity. In lay terms, it represents the change in velocity of the vehicle during a crash event. Delta-V is usually calculated using damage reconstruction software and the mass and stiffness characteristics of the case vehicle and collision partner must be known. Expressed as km/h.

DITRDCA	Department Of Infrastructure, Transport, Regional Development, Communications and Arts
DSSAD	Data Storage System for Automated Driving
EBA	Enterprise Bargaining Agreement
eCALL	Emergency Call (see ACN)
ECIS	Enhanced Crash Investigation Study (in-depth crash investigation study, conducted by MUARC)
ECM	Engine Control Module
ECU	Engine Control Unit
EDR	Event Data Recorder
EDR/DSSAD-IWG	EDR/DSSAD Informal Working Group (includes SG EDR, Subgroup) https://wiki.unece.org/pages/viewpage.action?pageId=87621709
EGNOS	European Geostationary Navigation Overlay Service (satellite-based augmentation [navigation] system (SBAS), owned by European Commission
EMEA	Europe, the Middle East and Africa (region)
EMS	Emergency Medical System
EOBR	Electronic Onboard Recorders
ESF	Emergency Steering Function
ESV	Enhanced Safety of Vehicles (conference)
EU	European Union
FCAI	Federal Chamber of Automotive Industries
FCW	Forward Collision Warning
FMVSS	Federal Motor Vehicle Safety Standard (US vehicle regulation)
FSI	Fatality and Serious Injury crash
GDPR	General Data Protection Regulation
GIT	Global Information Technology
GLONASS	GLObalnaya NAvigatsionnaya Sputnikovaya Sistema (Russian satellite navigation system)
GPS	Global Positioning System (US owned satellite navigation system)
GRSG	Working Party on General Safety Provisions
GRVA	Working Party on Automated/Autonomous and Connected Vehicles
GSR	General Safety Regulation (includes GSR-2)
GTR	Global Technical Regulation
GVM	Gross Vehicle Mass
GVWR	Gross Vehicle Weight Rating
H-III / H III	Hybrid III (3), ATD
HREC	Human Research Ethics Committee
HVEDR	Heavy Vehicle Event Data Recorder
ICT	Information and Communications Technology
Impact speed	Vehicle speed at impact. Impact speed is relevant to injury severity and hence is therefore upon impact configuration in multiple-vehicle crashes where a distinction is made between the striking and struck vehicle. This differs from vehicle speed at impact (see below).
ISO	International Organization for Standardization

IWG	Informal Working Group
Km/h	Kilometres per hour
KMVSS	Korea Motor Vehicle Safety Standards (South Korea)
LDW	Lane Departure Warning
LKA	Lane Keep Assist
LNG	Liquefied Natural Gas (vehicle fuel)
MCIU	Major Collision Investigation Unit
MOLIT	Ministry of Land, Infrastructure and Transport (South Korea)
MSD	Minimum Data Set (see ACN)
MUARC	Monash University Accident Research Centre
MY	Model Year (of vehicle)
NCAP	New Car Assessment Program
NHMRC	National Health and Medical Research Council
NHTSA	National Highway Traffic Safety Administration (United States)
NPRM	Notice of Proposed Rulemaking (issued by NHTSA)
NSW	New South Wales
ODB2	On-Board Diagnostic II (diagnostic) unit (second generation)
OEMS	Original Equipment Manufacturer (i.e., vehicle manufacturer)
PASP	Public-safety answering Point (may be used in ACN or eCALL services)
PCM	Powertrain Control Module
PDS	Product Disclosure Statement
PTW	Powered Two-Wheeler
R&D	Research and Development
RCM	Restraints Control Module (applicable to Tesla)
RIS	Regulatory Impact Statement
RVSA	*Road Vehicle Standards Act 2018 (Cth)*
SAE	Society of Automotive Engineers (now SAE International)
SIRA	State Insurance Regulatory Authority (NSW)
SRS	Supplementary / supplemental Restraint Systems (i.e., seat belt, airbag)
SUV	Sports Utility Vehicle
TAC	Transport Accident Commission (compulsory third-party insurer for Victoria)
Tier 1	Companies that supply vehicle parts or systems directly to vehicle manufacturers (OEMs)
TPS	Third Party Services (used in crash notification systems)
Travel speed at impact	The speed of the vehicle at the time of impact
TRL	Transportation Research Laboratory (located in Crowthorne, UK)
UCSR	Used Car Safety Rating (produced by MUARC)
UN	United Nations
UN ECE	United Nations Economic Commission for Europe

UN GTR	United Nations Global Technical Regulation
UN R	United Nations Regulation
UN R 144	United Nations Regulation Number 144, Accident Emergency Call Components (AECC)
UN R 160	United Nations Regulation Number 160, Event Data Recorder (EDR)
UN R 169	United Nations Regulation Number 169, Heavy Vehicle Event Data Recorder (EDR)
USA / US	United States of America
USD	United States dollar ($)
Vic	Victoria (State in Australia)
VIN	Vehicle Identification Number
VRU	Vulnerable Road User
VSS	Vehicle Speed Sensor
WP.29 IWG	Working Party 29 Informal Working Group
YTD	Year-to-date (in relation to vehicle sales)

1 INTRODUCTION

1.1 BACKGROUND AND PROJECT CONTEXT

Event Data Recorders (EDR) are a vehicle technology that dynamically stores vehicle sensor data. Data points relate to driver inputs and the status of vehicle safety systems. In the event of a crash or conditions of a pre-defined 'trigger' being met, such as a hard braking event that causes rapid deceleration, the data is locked into the EDR. Access to the stored EDR data requires specialist equipment. The data stored by the EDR is of value not only to manufacturers of vehicles who wish to monitor and optimise the performance of vehicle safety systems, but also to crash investigators and academic researchers.

EDR systems are installed on passenger cars that are fitted with an airbag. This is because the EDR system is implemented as part of the Airbag Control Unit (ACU). The implementation of EDRs in heavy vehicles (HVEDR) differs in that EDR data elements are stored in the Engine Control Module (ECM), which is part of the vehicle management and diagnostic system. Despite this difference the data elements stored in the EDR and HVEDR systems can be the same.

EDR technology (including HVEDR) has been the subject of regulatory discussions globally since the early 2000s. The United States (US) was an early adopter of EDR technology, with regulations establishing uniform requirements for EDR data elements and access rights as far back as 2006. While the US regulation (49 CFR Part 563) did not mandate the fitment of EDR systems, the regulation did specify uniform minimum requirements where EDRs were fitted into vehicles that had a Gross Vehicle Weight Rating (GVWR) of 3,855 kg or less and an unloaded vehicle weight of 2,495 kg. The US Regulation 49 CFR Part 563 also required manufacturers to facilitate access to the EDR data. With the US regulation coming into effect for vehicles sold from 1 September 2012 onwards, commercial systems to access EDR data were rapidly developed and made available for purchase. The value of EDR data was quickly recognised and country specific regulations were subsequently implemented, although these were based largely on the US regulation.

An important step was the decision taken by the European Union (Parliament) in 2019 to mandate the fitment of EDRs. This was done through the *General Safety Regulation (GSR-2)* (EU) 2019/2144 (27 November 2019).

Concurrent with the EU regulatory moves, the technical working group responsible for the development of United Nations Regulations (UN R) were formalising regulations for EDR technology as they apply to passenger vehicles and to heavy vehicles; these regulations were implemented as UN R 160 (passenger vehicles) [30 September 2021] and UN R 169 (heavy vehicles) [19 June 2024], respectively. Consequently, these UN Regulations must now be considered for implementation in Countries that are signatories to various United Nations *Agreements,* including Australia.

Following this accepted global protocol, the EU implemented UN R 160 and UN R 169 as EU Regulations via enabling *Delegated Regulations*, thereby meeting the requirements of GSR-2 in relation to the fitment of EDR technology to vehicles. Importantly, the EU adopted additional requirements concerning EDR data retrieval and privacy protections that were seen relevant to the EU. Throughout the EU the fitment of EDRs was made mandatory from 6 July 2022 for new light passenger vehicle models and from 7 July 2024 for all new passenger vehicles sold. The fitment of EDRs was made mandatory for new heavy vehicle models from January 7, 2026 (new types) and for all new heavy vehicles sold from January 7, 2029.

Within the context of these international developments, the Australian Government formulated an *Issues Paper* with respect to Event Data Recorders.[2] The *Issues Paper* highlighted questions pertaining to the alignment of any future ADR with the UN and/or US Regulation(s) with respect to included data elements, ownership and retrieval of EDR data, access to and storage of EDR data, factors impacting public acceptance of EDR technology, and inputs for a regulatory impact assessment. The benefits of EDR data to research was also noted.

A recognised challenge when considering a future EDR mandate is that the benefits of EDR data come from its use. This use first depends both on a crash of sufficient severity occurring so that the specified data is recorded and locked, and secondly that the data is accessed for use by police, insurance companies and researchers when investigating crashes or to examine specific research questions. Having said this, the role of the EDR in managing the deployment of airbags and seatbelt pretensioners, as well as in facilitating automatic crash notification systems, must be recognised.

[2] Australian Government – Department of Infrastructure, Transport, Regional Development, Communication and the Arts. (2022) Event Data Recorders: Issues Paper. (October 2022).

With the above in mind, this project was initiated to provide further insight into the range of issues identified by the Australian Government in the EDR *Issues Paper* with respect to potentially mandating EDR technology at first supply for vehicles into Australia. This includes an examination of the likely benefits of such a mandate.

1.2 OBJECTIVES AND STRUCTURE

The objectives of this *Report* were to examine the likely benefits and costs of a mandate at first supply Event Data Recorder (EDR) systems fitted to Category M (passenger vehicles) and Category N vehicles (commercial vehicles). Specifically, this report seeks to:

a) Establish a framework for use in a future regulatory impact assessment and provide inputs for use in the formulation of a *Regulatory Impact Statement (RIS)*.

b) Define the anticipated benefits of a mandate of EDR technology.

c) Provide financial estimates of benefits and costs associated with EDR fitment insofar as possible.

This *Report* is structured as follows:

- Chapter 2 provides a description of the methods used in this project.
- Chapter 3 provides a description of EDR technology, current regulations and standards, and provisions concerning retrieval and privacy. This includes an examination of legislation in Australia, Europe and the United States; reference is also made to Court determinations regarding EDR use.

  Chapter 3 also provides a detailed description of EDR data retrieval, including current costs. Coverage of Australian vehicles by EDR data retrieval systems is examined using crash data and vehicle sales data.
- Chapter 4 focuses on the use and hence benefits of EDR data. Consideration is given to the role of EDR data as enabling academic research; as a mechanism for the design and optimisation of vehicle safety systems; in facilitating automatic crash notifications system, and as key input to forensic crash investigation conducted by the police and insurance industry.
- Chapter 5 aims to bring the key points and findings of the *Report* together. Of particular interest is identifying the range of benefits and considerations for use in any future regulatory impact assessment regarding mandating EDR technology for vehicles at first supply into Australia through the *Australian Design Rule (ADR)* system.
- Appendix 6 provides details of the key features, requirements, applicability, and data elements (and their definition) of UN R 160 (passenger vehicles) and UN R 169 (heavy vehicles).
- Appendix 7 provides data tables relating to vehicles involved in crashes, by type and age at the time of the crash. This is provided for use in any future *Regulatory Impact Statement* where Benefit-Cost Ratios (BCRs) may be calculated.

1.3 USE OF THIS REPORT

This report has been prepared by MUARC to provide the Department of Infrastructure, Transport, Regional Development, Communications and Arts (DITRDCA) insight into the potential benefits of mandating EDR for passenger vehicles and heavy vehicles (i.e., Category M and N vehicles).

Any decision to mandate EDRs rests solely with the Department of Infrastructure, Transport, Regional Development, Communications and Arts (DITRDCA) and the Australian Government.

2. PROJECT METHODS

This chapter provides an overview of the *Methods* adopted and data sources used in undertaking this research.

2.1 REVIEW OF EDR REGULATIONS AND STANDARDS

Regulations pertaining to EDR technology were examined. Information sources included:

- UN EDR Regulations, obtained through UN websites.
- EU EDR Regulations, obtained through EU websites.
- US EDR Regulation, obtained through the US Federal Register and the NHTSA website.
- Material from the WP.29 Informal Working Group on EDR/DSSAD.
- For Japan, information was obtained from the Japanese Ministry of Transport.
- For Australia, reference was made to the Australian Design Rules, with information obtained from the Australian Government website.
- SAE Standards were accessed using SAE Mobilus, through Monash University.

2.2 REVIEW OF EDR DEVICE TECHNICAL SPECIFICATIONS, DATA ACCESS, AND FORMATS

Detailed technical and vehicle coverage information was gathered from providers of EDR crash data retrieval systems. This included information from Bosch, Tesla, and the Hyundai Group. Cost information was obtained through third-party commercial product suppliers based in the United States and Europe.

Material from a range of technology provider websites was also used.

2.3 EDR RETRIEVAL COVERAGE OF THE AUSTRALIAN FLEET AND CRASH-INVOLVED VEHICLES

To enumerate the number of vehicle models and proportion of crash-involved vehicles supported by EDR crash data retrieval systems the following data was used:

1. Vehicle models where EDR data download was supported were identified using information available from Bosch, Tesla, and Hyundai / KIA.
2. The 2024 MUARC Used Car Safety Rating report was used to identify vehicle models involved in crashes.
3. Vehicle sales data for the 2024 calendar year made available by the Federal Chamber of Automotive Industries (FCAI).

In addition, crash data for the period 2019 – 2022 from NSW was used to document the number of vehicles involved in crashes by vehicle age. This was provided for use in a future Regulatory Impact Statement (RIS) where the likely costs and benefits of an EDR mandate may be modelled using fleet penetration rates.

2.4 REVIEW OF LAWS PERTAINING TO DATA OWNERSHIP AND ACCESS

In addition to material referred to in Section 2.1, the legal databases Westlaw US & International (Westlaw Classic Thomson Reuters), and Lexis Premium / Lexis+ Australia. These databases include legislation and case law, including as it applies in the United States, Europe and Australia. Specific legislation and Court cases were accessed. Monash University has access to these databases.

2.5 REVIEW OF PUBLISHED STUDIES ON THE USE OF EDR DATA IN VEHICLE AND ROAD SAFETY RESEARCH, IN POLICING, AND IN FORENSIC SETTINGS (INCLUDING INSURANCE)

To define the use cases, and hence benefits of using EDR data, two approaches were taken.

1. Examination of published academic and grey literature. This included use of academic databases (Medline, Transport, SAE), conference proceedings (ESV, STAPP), reports from relevant academic organizations (i.e., CASR, TRL UK), and specialist reports found through targeted searches using Google Scholar.
2. Interviews with subject matter experts. Interviews were conducted with Police involved in the forensic investigation of crashes, staff of a commercial provider of forensic crash investigation service to the insurance industry, and research users of EDR data. To ensure consistency of interviews, a question proforma was developed. Items related to current uses of EDR data, considerations concerning ownership and access, equipment used and technical considerations, data points of interest, use in crash reconstruction and forensic investigations, and methods of data validation. Interviews ranged from 65 – 100 minutes.

3 EDR REGULATIONS, TECHNICAL SPECIFICATIONS, DATA POINTS, ACCESS CONSIDERATIONS AND COVERAGE OF VEHICLES SOLD IN AUSTRALIA

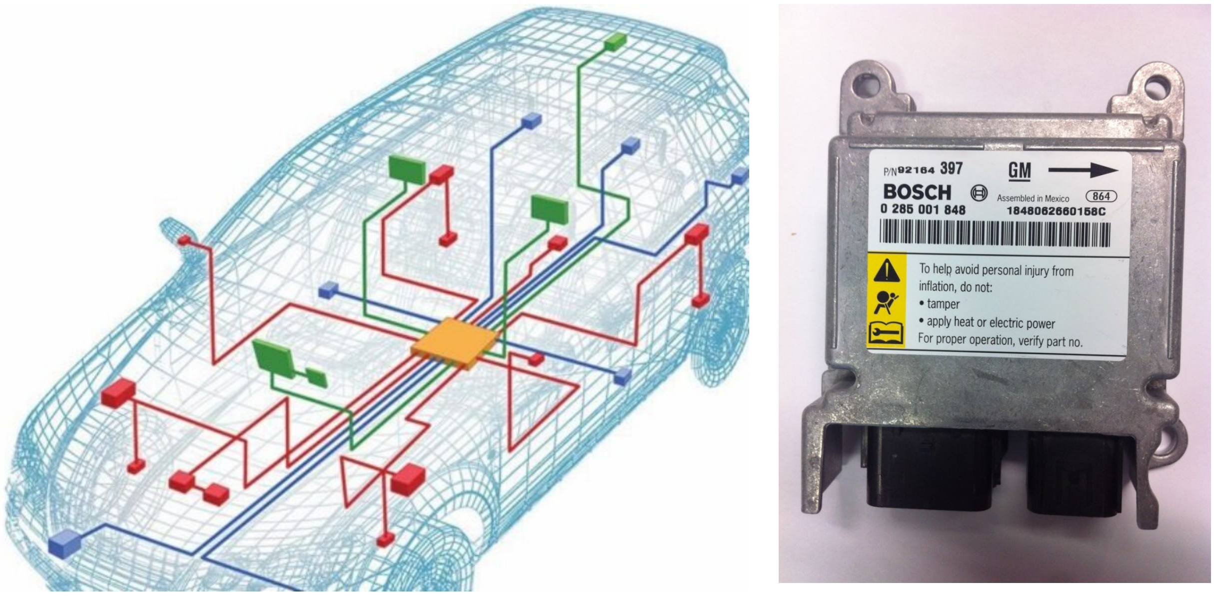
This chapter introduces EDR technology and provides a description of current regulations that govern their implementation, applicability, function, included data elements, and access. Provisions relating to data ownership and privacy requirements associated with EDR data access are outlined where applicable. Technical requirements and costs relating to EDR data retrieval are discussed; this step enables an estimation of the proportion of Australian vehicles involved in crashes and new vehicles sold that have an EDR fitted where the data can be read.

The information presented in this chapter provides a basis for understanding the uses, and hence benefits, of EDR data.

3.1 INTRODUCTION TO EDR DATA

Event Data Recorders (EDR) capture specified data points from vehicle sensors (Figure 3.1). For passenger vehicles with an airbag fitted, the EDR is located within the Airbag Control Module / Unit (ACU) (Figure 3.1, Figure 3.2). For heavy vehicles comparable data normally sits within the Engine Control Module (ECM). In heavy vehicles the EDR is referred to as the HVEDR. Irrespective of its location, data is stored dynamically on a memory card in 'volatile memory' until a pre-defined event trigger is detected,[3] whereupon the data across all parameters is locked and stored in 'non-volatile memory'. This locked data can be downloaded using crash data retrieval tools.

Event triggers include airbag deployment for passenger vehicles and hard braking events for heavy vehicles, for example. When driving normally data is being collected but is constantly overwritten. The time duration of locked data differs for each data point but does not generally extend more than 5 seconds prior to a detected event. For crash data points, such as deceleration, data for up to 300 ms is stored. Enacted *Regulations* define the trigger events to lock the data, as well as the stored data points and their timings (see Section 3.2).

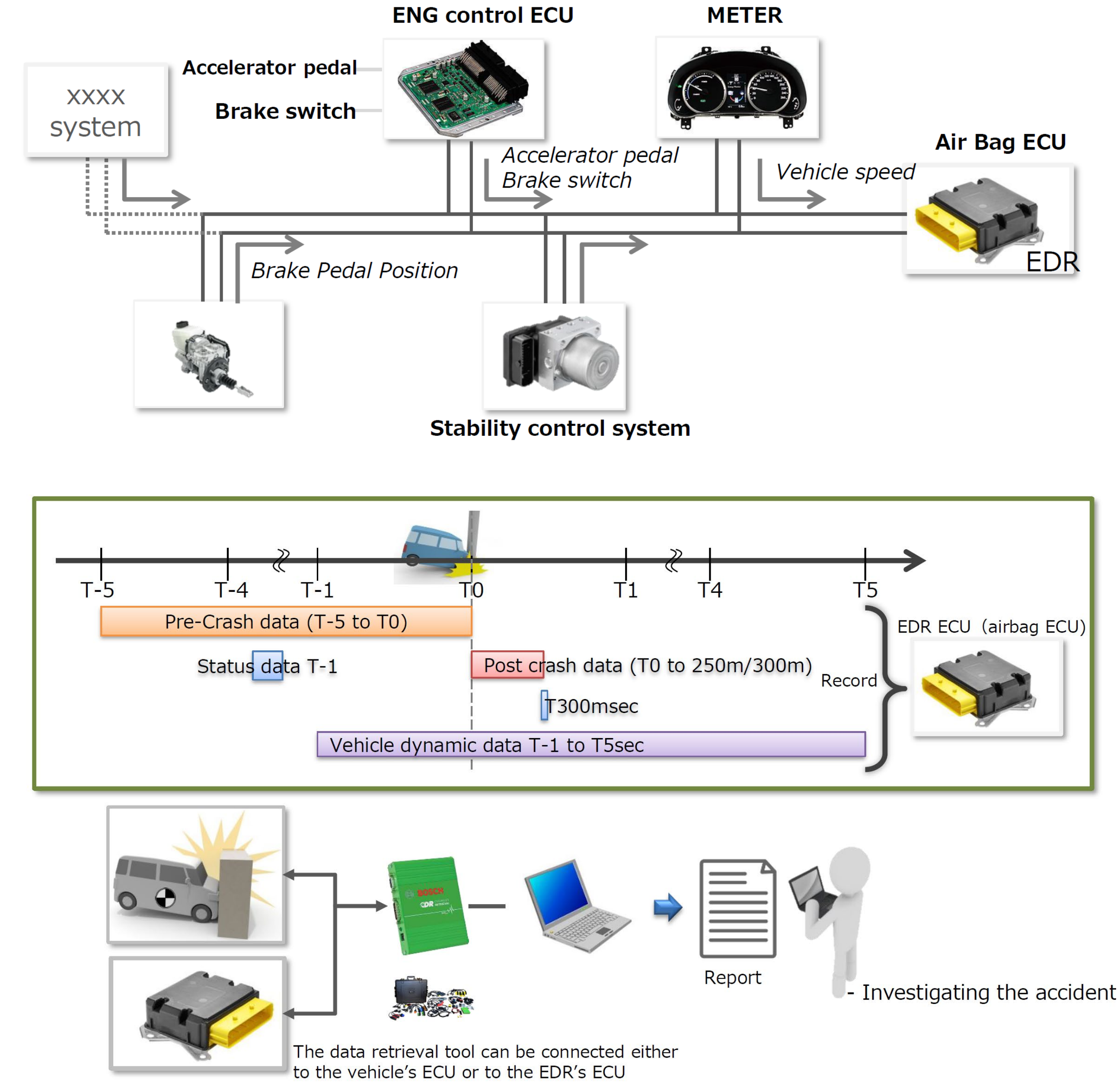


Source: Event Data Recorder to be mandatory for all new vehicles (eeNewsAutomotive); ACU / EDR recovered by MUARC from a vehicle crash.

FIGURE 3.1 SCHEMATIC REPRESENTATION OF AN EDR FITTED TO A VEHICLE (YELLOW SQUARE) WITH VEHICLE SENSORS SHOWN (LEFT PANEL), AND AN ACU/EDR RECOVERED BY MUARC FROM A CRASHED VEHICLE (RIGHT PANEL)

[3] An algorithm uses dynamically collected vehicle sensor data to make this determination.

Figure 3.2 provides examples of the range of vehicle sensors that feed into the EDR, as well as the type of data collected when a crash occurs. Also seen is the crash data retrieval process by the crash investigator.



SOURCE: The Overview of EDR. Presented by Japan to EDR WP.29 IWG (8 July 2019). (Link; see footnote).

FIGURE 3.2 REPRESENTATION OF DATA COLLECTED BY AN EDR IN RELATION TO A CRASH AND THE DATA RETRIEVAL PROCESS[4]

[4] EDR-DSSAD-01-06 (J) Overview of EDR.pdf; EDR/DSSAD-IWG-01, Presented at Brussels, 8-9 July 2019.

Data stored by the EDR and later retrieved is incredibly valuable for the investigation of crashes and the conduct of research. These represent secondary use cases for the stored data, with the primary use being its role in the management of vehicle safety systems including airbags and crash notification systems. Vehicle manufacturers also reportedly use EDR data to improve the safety of their vehicles, including the optimisation of airbag performance and seat belt pretensioner systems.

The EDR data provides an objective record of key vehicle metrics, including vehicle speed, accelerator pedal position, and braking. Exemplar pre-crash data from an EDR is shown below (Figure 3.3). This shows that at 0.5 seconds before impact, the vehicle was travelling at 78.8 km/h, and the driver was not braking. Under the various established *Regulations* considerably more data elements are stored in EDR systems, including steering inputs and cruise control status. The value of this data to crash investigators including police is self-evident.

Pre-Crash Data

Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Vehicle Speed (MPH)	51	51	51	50	49
Engine Speed (RPM)	1344	1280	1152	1088	960
Accelerator Pedal Position (percent)	14	0	0	0	100
Percent Throttle	17	9	9	9	93
Brake Switch Circuit State	OFF	OFF	OFF	OFF	OFF

FIGURE 3.3 PRE-CRASH DATA RETRIEVED FROM AN EDR

While EDR data is invaluable for a range of purposes (see Chapter 4), standardisation of EDR data via *Regulations* is important to consistency across vehicles and markets where vehicles are sold. Doing so has efficiencies for manufacturers but also provides certainty to end users of EDR data. Regulations concerning EDR technology, data elements, and retrieval are presented in the following section.

3.2 EDR REGULATIONS

The global vehicle regulatory framework is complex. While individual countries have their own laws concerning motor vehicle standards and rules, the United Nations (UN) plays a key role in establishing uniform requirements through UN Regulations (UN R), UN Global Technical Rules (GTR), and UN Rules.[5] The global legal framework rests on two UN vehicle *Agreements (dated:* 1958; 1998). These *Agreements* permit member countries, known as Contracting Parties, to participate in the UNECE World Forum for Harmonization of Vehicle Regulations (WP.29). The WP.29 is responsible for developing and establishing Regulations and Rules that govern motor vehicles.

Australia is a signatory to the 1958 and 1998 vehicle UN *Agreements*. This confers responsibilities on the Australian Government, including to formally consider whether to implement UN Regulations and other established rules within set timeframes.

Like other Countries, Australia has its own regulatory system that governs motor vehicles. Under the *Road Vehicle Standards Act 2018* (RVSA), a system of rules known as *Australian Design Rules (ADR)* exist.[6] The ADRs give rise to minimum standards that must be met for vehicles to be sold in Australia. This is done with the intention of providing a high level of vehicle safety for the Australian community.

With this brief introduction in mind, this section aims to document relevant regulations as they apply to EDR technology.

3.2.1 UN REGULATIONS ON EDR AND DATA

The development of UN Regulations relating to Event Data Recorders rests with the Informal Working Group (IWG) on Event Data Recorder and Data Storage System for Automated Driving (EDR/DSSAD), known as the WP.29 EDR/DSSAD Informal Working Group (IWG).[7] The IWG was established in 2019.

Within the WP.29 structure, the EDR/DSSAD IWG is Co-Chaired by, and therefore reports to, the Working Party on Automated/Autonomous and Connected Vehicles (GRVA) and the Working Party on General Safety Provisions (GRSG). The IWG is Co-Chaired by a representative from Japan, the Netherlands, and the United States.[8]

With EDR technology and the Data Storage System for Automated Driving (DSSAD) both being data capture systems, it is useful to understand their differences. These differences relate to the type of information captured by each device and its use purpose. Data points included within the EDR are those that relate to crashes. In contrast, the DSSAD system includes data points that relate to the automated/autonomous driving system (AD/ADS mode) and hence, the status of the driver and whether they are in charge of the vehicle.[9]

Following considerable work over many years by the EDR/DSSAD IWG, UN Regulation 160 (EDR for light vehicles) and UN Regulation 169 (heavy-duty vehicles) were established. These regulations define the purpose, requirements, applicability, and data elements for EDRs fitted to vehicles.

The value of these *Regulations* is that they specify uniform technical requirements for EDRs, this being crucial in a global vehicle market. The *Regulations* in and of themselves do not mandate the fitment of EDR into vehicles; this responsibility rests with each Country (i.e., Contracting Party). Of note, the EU through the *General Safety Regulation (GSR, see below)* has mandated EDRs, with Delegated Regulations specifying the adoption of UN R 160 and UN R 169.

For Australia, the decision on whether or not to mandate EDR technology as an ADR through the *Road Vehicle Standards Act 2018* (RVSA) rests with the Australian Government. It is worth noting that as a Contracting Party to the established UN vehicle *Agreements,* the Australian Government has a stated preference to harmonise its ADRs with the UN Regulations insofar as possible.

The technical details of UN R 160 and UN R 169 are presented in a series of Tables in Appendix 6. This includes the scope of each Regulation and the data captured. Data element definitions are also included in Appendix 6.

[5] UN. WP.29 – Introduction. https://unece.org/wp29-introduction#accordion_0

[6] Australian Government. Australian Design Rules. https://www.infrastructure.gov.au/infrastructure-transport-vehicles/vehicles/vehicle-design-regulation/australian-design-rules

[7] DSSAD/EDR IWG repository. https://wiki.unece.org/pages/viewpage.action?pageId=87621709

[8] IWG on EDR/DSSAD Status Report, October 2024. https://unece.org/sites/default/files/2024-10/GRSG-128-05e.pdf

[9] OICA. Informal document GRSG-116-42 (116th GRSG, 1-5 April 2019 Agenda item 17. Event Data Recorder (EDR). https://unece.org/DAM/trans/doc/2019/wp29grsg/GRSG-116-42e.pdf

This information provides context for the uses and hence benefits of EDR data. Comparisons can also be made between EDR specifications for light vehicles (UN R 160)[10] [11] and heavy vehicles (UN R 169).[12]

Noting that vehicle technology is constantly evolving, so to do *Regulations*. New data elements for inclusion into the EDR Regulations are already being considered (e.g., automated driving systems, driver monitoring [drowsy] systems), as are triggers relating to vulnerable road user interactions, and increased recording frequency; this is referred to as *EDR Step 2*. It is important then that any consideration to mandate EDRs in Australia keeps pace with these developments.

3.2.2 EU GENERAL SAFETY REGULATION (GSR) (REGULATION (EU) 2019/2144) [GSR 2]

The EU General Safety Regulation (EU 2019/2144) mandated the fitment of EDRs, however specific regulations were required to enable the mandate to take effect. The requirements for the mandatory fitment of EDRs for light passenger vehicles and heavy-duty vehicles are stated below, with executing *Delegated Regulations* also described.

- EDR fitment is mandatory for light passenger vehicles (M1, N1) from 6 July 2022 for new M1 and N1 category vehicle types, and for all new M1 and N1 vehicles (i.e. passenger cars, multipurpose passenger vehicles, pick-up trucks and vans).
    - Executed through *Commission Delegated Regulation (EU) 2022/545 of 26 January 2022 (link) (published 6 April 2022).*
    - Specifies that the test procedures and detailed technical requirements for type-approval of vehicle types with regard to EDRs are subject to the provisions of UN Regulation No 160.
    - Temporary provisions regarding approvals under UN Regulation No 160 applied. Specifically transition periods were established in relation for adoption of the UN R 160 01 Series amendments, such that from 6 July 2024 new vehicles must comply with the 01 Series text, however UN R 160 type approval granted outside the EU can continue to be accepted by national authorities until 1 July 2026. The applicable date for acceptance of new vehicle models was 1 July 2024. Appendix 6 includes the 01 Amendment text with applicable data points highlighted in grey.

      As with the EU, Australia can create any law as required. An ADR stipulating compliance with UN R 160 01 series of Amendments for first supply is arguably administratively most efficient.
- EDR fitment is mandatory for heavy duty vehicles (M2, M3, N2 and N3) from 7 January 2026 for new vehicle types, and from 7 January 2029 for all new vehicles.
    - Executed through *Commission Delegated Regulation (EU) 2024/2220 of 26 July 2024 (link to final document) (published 2 October 2024).*
    - Specifies that the test procedures and detailed technical requirements for type-approval of vehicle types with regard to EDRs are subject to the provisions of UN Regulation No 169.
    - Specifies requirements with regard to *Data security* (Article 3), *Data retrieval* (Article 4), and *Provisions for roadworthiness testing (Article* 5).

In addition to the specification of the technical requirements and data points per UN R 160 and UN R 169 for light passenger vehicles and heavy-duty vehicles respectively, the *EU Delegated Regulations* are clear on data retrieval requirements in Point 2 of Article 4 of UN R 160 and UN R 169 (see Table 3.1) Under these provisions vehicle manufacturers are required to provide third parties with technical information on how the EDR event data can be accessed, retrieved and interpreted. This provision is critically important in facilitating the development of third-party diagnostic tools and EDR data download and 'read' tools. That the EU has specified these legal requirements is important as both UN R 160 and UN R 169 are silent on this matter.

[10] UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].

[11] (01 amendments): UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022].

[12] UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].

TABLE 3.1 DATA RETRIEVAL REQUIREMENTS

LIGHT PASSENGER VEHICLES (EU) 2022/545, ARTICLE 4: DATA RETRIEVAL	HEAVY DUTY VEHICLES (EU) 2024/2220 ARTICLE 4: DATA RETRIEVAL
1. Crash-related data recorded by the event data recorders shall be made available for retrieval through the serial data port on the **standardised data link connector** referred to in point 2.9 of Annex X to Regulation (EU) 2018/858. **Where the serial data port is no longer functional after a collision, the data shall be retrievable by a direct connection to the event data recorder.**	1. Crash-related data recorded by the event data recorders shall be made available for retrieval through the serial data port on the **standardised data link connector** referred to in point 2.9 of Annex X to Regulation (EU) 2018/858. **Where the serial data port is no longer functional after a collision, the data shall be retrievable by a direct connection to the event data recorder.**
2. Vehicle manufacturer(s) **shall provide** the type-approval authority and, at the request of a type-approval authority, **any interested manufacturer or repairer of components, diagnostic tools or test equipment with information about how the event data can be accessed, retrieved and interpreted.**	2. Vehicle manufacturer(s) **shall provide** the type-approval authority and, at the request of a type-approval authority, **any interested manufacturer or repairer of components, diagnostic tools or test equipment with information about how the event data can be accessed, retrieved and interpreted.**
3. Vehicles and their event data recorders shall be designed in a way that enables a data retrieval tool to produce event reports that contain the following data elements: a) Each of the mandatory data elements, as required under UN Regulation No 160. b) The precise vehicle type, variant and version (including the fitted active safety and accident-avoidance systems) of the vehicle hosting the event data recorder.	3. Vehicles and their event data recorders shall be designed in a way that enables a data retrieval tool to produce event reports that contain the following data elements: a) Each of the mandatory data elements, as required under UN Regulation No 169 b) The precise vehicle type, variant and version (including the fitted active safety and accident-avoidance systems) of the vehicle hosting the event data recorder.
4. The data referred to in the point (b) above, shall also be available at the completion of the crash test referred to in paragraph 5.4.3 of UN Regulation No 160.	The manufacturer shall demonstrate that data referred to in the point (b) above are available after an impact referred to in paragraph 5.4.1 of UN Regulation No 169.
The data recorded by the event data recorder shall not be available for retrieval over interfaces accessible without the need to unlock the vehicle or to use tools, or over vehicle interfaces for wireless connections.	4. The data recorded by the event data recorder shall not be available for retrieval over interfaces accessible without the need to unlock the vehicle or to use tools, or over vehicle interfaces for wireless connections.
5. The event data recorder's data made available pursuant to paragraph 1: (a) shall be available in a machine-readable format; (b) shall not include or be made available together with any information allowing to relate those data to a natural person.	5. The event data recorder's data made available pursuant to paragraph 1: (a) shall be available in a machine-readable format; (b) shall not include or be made available together with any information allowing to relate those data to a natural person.

3.2.3 UNITED STATES (US) REGULATION 49 CFR PART 563

The United States led the way with respect to regulations concerning EDR technology having legislated Section 563.5 of Title 49, Code of Federal Regulations (49 C.F.R. § 563.3) in August 2006 (with revisions in 2008). This followed the issuance of a Notice of Proposed Rulemaking (NPRM) by the US NHTSA on June 14, 2004.[13] [14] [15] The regulation came into effect on 1 September 2012.

The scope, purpose and application of 49 CFR Part 563 are noted below:

- Scope (§ 563.1)
  - Sets uniform, national requirements for vehicles equipped with Event Data Recorders (EDRs) concerning the collection, storage, and retrievability of onboard motor vehicle crash event data.
  - Specifies requirements for vehicle manufacturers to make tools and/or methods commercially available so that crash investigators and researchers are able to retrieve data from EDRs.
- Purpose (§ 563.2)
  - Provisions to ensure that the EDR record is readily usable for the conduct of crash investigations and for the analysis of vehicle safety equipment (e.g., airbags), so as to enable a better understanding of crash circumstances and injuries which in turn will lead to safer vehicle designs.
- Application (§ 563.3)
  - Applicable to vehicles manufactured on or after September 1, 2012, if equipped with an Event Data Recorder. Vehicles include passenger cars, multipurpose passenger vehicles, trucks, and buses with a GVWR of 3,855 kg (8,500 pounds) or less and an unloaded vehicle weight of 2,495 kg (5,500 pounds).

The Regulation specifies the data elements (§ 563.3) and their format (§ 563.8) to be stored on the EDR that are then subject to being retrieved. The reader is referred to Tables 1, 2, and 3 of the Regulation for this information (Link), noting these are now similar to those in UN R 160. With regard to 'events', two are stored. Triggers for data capture and locking the EDR in non-volatile memory includes crashes where an airbag has deployed.

The Regulation specifies the storage of 5 seconds of pre-crash data for select data elements (e.g., vehicle indicated speed, braking). A recent (2022) NHTSA *Notice of Proposed Rulemaking*[16] proposed extending the duration of pre-crash data stored to 20 seconds. The implementation status of this proposed change is unknown.

The Regulation was also clear on the requirements relating to information concerning the fitment of the EDR in the vehicle owner's manual. This information included the purpose of the EDR and specified that no data is recorded (i.e., stored) under normal driving conditions, and that no personal data (e.g., name, gender, age, crash location) are recorded. The consumer information text also stated that:

> 'To read data recorded by an EDR, special equipment is required, and access to the vehicle or the EDR is needed. In addition to the vehicle manufacturer, other parties, such as law enforcement, that have the special equipment, can read the information if they have access to the vehicle or the EDR. (§ 563.3).

The Regulation also required manufacturers EDR data could be readily accessed. Specifically, the Regulation stated:

> Each manufacturer of a motor vehicle equipped with an EDR shall ensure by licensing agreement or other means that a tool(s) is commercially available that is capable of accessing and retrieving the data stored in the EDR that are required by this part. The tool(s) shall be

[13] Part 563 – Event Data Recorders. https://www.ecfr.gov/current/title-49/subtitle-B/chapter-V/part-563, as in 71 FR 51043 Aug. 28, 2006.

[14] NHTSA. Event Data Recorders. https://www.nhtsa.gov/research-data/event-data-recorder

[15] NHTSA. 49 CFR Part 563, Final Rule. [Docket No. NHTSA-2008-0004]. Federal Register Volume 73, Number 9 (Monday, January 14, 2008)]. https://www.govinfo.gov/content/pkg/FR-2008-01-14/html/E8-407.htm

[16] National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT). Notice of proposed rulemaking NPRM – Part 563, Event Data Recorders, Minimum Time Capture for Pre-Crash Data (FAST Act) RIN: 2127-AM12. [Docket No. NHTSA-2022-002). https://www.federalregister.gov/documents/2022/06/22/2022-12860/event-data-recorders

> commercially available not later than 90 days after the first sale of the motor vehicle for purposes other than resale. (§ 563.12 Data retrieval tools)

As further discussed in Section 3.4 (below), this data retrieval provision has been critically important to ensuring the universal EDR download and read coverage of vehicle models sold in the United States by third-party EDR crash data retrieval system providers.

It is important to note that the Regulation did not mandate the fitment of EDR technology, rather the Regulation set the uniform requirements of data elements where EDRs are fitted in vehicles, as well as the nature of information to be provided to the vehicle owner and provisions relating to data retrieval.

In establishing the Regulation, NHTSA and others[17] pointed to the value of the EDR data, stating[18] -

> The stored data are extremely valuable for crash investigation, defect identification and verification, safety research, and developing emergency response systems (i.e., automatic crash notification / eCALL). (p. III – 1)

In the Final Rule [Docket No. NHTSA-2006-25666][19], under Section F - Impacts of the Final Rule, it was stated that –

> It is difficult for the agency to quantify the benefits expected to result from this final rule for standardization of EDR data. That is because the EDR devices themselves are not designed to be systems for crash avoidance or crashworthiness, but instead they offer an important tool to enable better EMS response and to better understand crashes and crash-related events. However, it is possible to describe the benefits of EDRs in qualitative terms. (p.22).

This sentiment was repeated in 2012 when considering an EDR mandate -

> Although the agency believes that the proposal will improve vehicle safety, the safety benefits are difficult to quantify. Therefore, the benefits of this proposal (to mandate) are discussed qualitatively. (p. III – 1)

Costs of the Regulation were estimated to be low (USD$ 0.17 per vehicle) due to the fitment rate (64%) at the time the rule was developed in 2005.

In considering whether to mandate EDR technology for vehicles sold in Australia, these statements by NHTSA are important to consider.

Finally, it is worth noting that in February 2019 NHTSA withdrew its 2012 NPRM on converting 49 CFR Part 563 to a mandatory regulation due to the finding that nearly all new vehicles sold had an EDR fitted, noting that consideration of a mandate for the fitment of EDRs was on the basis some vehicles were not being fitted with the EDR device.[20] It remains that case that the rule as passed, 49 CFR Part 563, has been very successful in ensuring the both the uniformity of EDR data and that the data can be retrieved by third parties for use in a range of applications outside of the vehicle.

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[17] Gabler H.C., Gabauer D.J., Newell H., O'Neill M.E. (2004). Use of Event Data Recorder (EDR) Technology for Highway Crash Data Analysis. Transportation Research Board of the National Academies, Washington, DC. https://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w75.pdf Note: this report is an excellent resource for understanding EDR data.

[18] US Department of Transportation, NHTSA.(2012). FMVSS No. 405 Event Data Recorders (EDRs), Preliminary Regulatory Evaluation. Office of Regulatory Analysis and Evaluation National Center for Statistics and Analysis. Washington, DC.

[19] US Department of Transportation. National Highway Traffic Safety Administration 49 CFR Part 563 [Docket No. NHTSA-2006-25666] RIN 2127-AI72 Event Data Recorders. https://www.nhtsa.gov/sites/nhtsa.gov/files/edrfinalrule_aug2006.pdf

[20] National Highway Traffic Safety Administration 49 CFR Part 563 [Docket No. NHTSA–2012–0177] RIN 2127–AK86 Federal Motor Vehicle Safety Standards; Event Data Recorders. Federal Register / Vol. 84, No. 27 / Friday, February 8, 2019 / Proposed Rules.

3.2.4 OTHER REGULATIONS: KOREA, JAPAN, CHINA AND RUSSIA

While a complete guide concerning vehicle regulations by country can be found here,[21] EDR Regulations of note include:

- Korea EDR Regulation KMVSS 56-2 (MOLIT Ord. 534/2018).
  - Key dates: introduced 2008 and revised in 2019; applicable if EDR fitted.[22]
- Japan EDR Regulation J-EDR (Kokujigi 278/2008/2015).[23]
  - Mandatory if fitted for passenger vehicles less than 10 people. Introduced in 2008[24] and revised in 2015 by the Ministry of Land, Infrastructure, Transport and Tourism.
  - Modelled on US 49 CFR Part 563.
- China EDR Regulation GB39732-2020, China Compulsory Certificate (CCC) Regulations.[25] [26]
  - In December 2020 China published GB39732-2020 Vehicle Event Data Recorder System to replace GB39732-2017; this requires passenger cars to be equipped with an EDR from January 1, 2022 (GB 7258-2017 / XG1-2019).
  - Under GB 7258-2017 the fitment of an EDR is mandatory.
  - The data recorded by the EDR is divided into Level A and Level B. There are 17 data elements for Level A EDR systems and 43 elements for Level B EDR systems (devices with relevant functions including ADAS), effective from January 1, 2022, and January 1, 2024, respectively. Vehicles must be fitted with either an EDR per GB 39732-2020, or an on-board driving video recording system meeting the requirements of GB/T 38892-2020.
  - Includes specification of 1) Unified Data Retrieval Connector; 2) a Unified Data Retrieval ID for the three stored trigger events, and 3) Unified Data Retrieval Protocol per ISO 14229-1:2020.
- Russian Federation Automobile Vehicles On-Board Devices Event Registrations - General Technical Requirements and Test Methods first draft, as required by Article 26 of Federal Law 162-03 of June 29, 2015.
- India: Draft standard, *AIS 192 Event Data Recorder*, is under development and is aligned with UR R 160 (Link)

The implementation of these EDR Regulations by Countries that have a strong vehicle manufacturing industry highlights the high value placed on standardised EDR data. That these EDR Regulations are in effect is an important consideration given the large number of vehicles manufactured in these Countries that are sold in Australia, although this ought not be a barrier to Australia adopting its own regulations given the advantages of harmonisation with UN Regulations.

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[21] ACEA. The Automotive Regulatory Guide 2023. European Automobile Manufacturers Association. Belgium. https://www.acea.auto/publication/automotive-regulatory-guide-2023/

[22] South Korea Motor Vehicle Type Approval, https://www.atic-ts.com/korea-motor-vehicle-certification/

[23] Takubo, N., Ishikawa, H., Kato, K., Okuno, T. et al., Study on Characteristics of Event Data Recorders in Japan. SAE Technical Paper 2009-01-0883, 2009. https://doi.org/10.4271/2009-01-0883.

[24] J-EDR technical requirement, http://www.mlit.go.jp/; see also: J-EDR: https://www.mlit.go.jp/kisha/kisha08/09/090328/01.pdf; technical requirements EDR: https://www.mlit.go.jp/report/press/content/001708447.pdf; summary of technical requirements for HVEDR: https://www.mlit.go.jp/report/press/content/001708447.pdf

[25] China Automotive Event Data Recorder (EDR) Industry Report 2022. (Link).

[26] C-EDR – Introduction of Chinese Mandatory Standard GB 'Automobile Event Data Recorder. (Link).

3.2.5 SAE INTERNATIONAL EDR RECOMMENDED PRACTICE IN RELATION TO EDR DATA

The SAE, through its Event Data Recorder Committee, have defined a series of Recommended Practice documents for EDR technologies. These Recommended Practice documents have been influential, particularly in the US context, with the SAE also making contributions to the WP.29 EDR/DSSAD IWG. For instance, the SAE have made recommendations for WP.29 for a single EDR Global Technical Regulation (GTR) and have argued against a Virginia Tech Report on increasing the EDR pre-crash recording period from 5 seconds to 20 seconds.[27] In recognition of the role of the SAE with regard to EDR technology, the relevant SAE Standards are identified below.

For passenger vehicles, the SAE J1698 series (first developed in 2003), dated 2023-03-01, consists of the following documents (from: https://www.sae.org/standards/content/j1698_202303/):

- SAE J1698-1 - Event Data Recorder - Output Data Definition: Provides common data output formats and definitions for a variety of data elements that may be useful for analysing vehicle crash and crash-like events that meet specified trigger criteria (https://www.sae.org/standards/content/j1698/1_202301/).
- SAE J1698-2 - Event Data Recorder - Retrieval Tool Protocol: Utilizes existing industry standards to identify a common physical interface and define the protocols necessary to retrieve records stored by light duty vehicle Event Data Recorders (EDRs) (https://www.sae.org/standards/content/j1698/2_202307/; date: 2023-07-14).
- SAE J1698-3 - Event Data Recorder - Compliance Assessment: Defines procedures that may be used to validate that relevant EDR output records conform with the reporting requirements specified in Part 563, Table 1 during the course of FMVSS-208, FMVSS-214, and other applicable vehicle level crash testing (https://www.sae.org/standards/content/j1698_202303/)

The SAE also have a Pedestrian Protection EDR Output Data Definition Recommended Practice document (J1698/1A_202104, date: April 2021). The data points relate to pedestrian protection systems.

Interestingly SAE J1698-1 includes the event date and event time, among other variables that are captured by the UN Regulations. Neither event date nor event time are included data points in UN R 160 or UN R 169.

With regard to HVEDR, the SAE have also published the *Heavy Vehicle Event Data Recorder (HVEDR) J2728_202011* document *(https://www.sae.org/standards/content/j2728_202011/; 2020-11-30).* This document 'provides nomenclature and references to related documents for heavy vehicle event data recorders (HVEDR) for heavy-duty (HD) ground wheeled vehicles'.

In addition, the SAE set a range of standards for a host of vehicle components, including connection ports, required to read EDR data (e.g., SAE J1962_201607; Link).

[27] SAE International. The SAE EDR Committee's Response to NHTSA's Report to Congress on Event Data Recorders (EDR) Duration Study (31/7/2020); Link.

3.3 REGULATORY REQUIREMENTS AND PRIVACY LAW CONSIDERATIONS

3.3.1 REGULATORY STATEMENTS ON RETRIEVABILITY

While EDR data provides invaluable insights for use in forensic investigations and research, data from the EDR must first be downloaded for benefits to be realised. As shown, this is a complex technical process.

It is worth emphasising that the none of the EDR regulations speak to uniform access and download requirements; that is, the mandate of a single hardware and software system, noting however the role of the SAE Standards with respect of uniform parts including connectors.

Historically manufacturers have used EDR data to improve occupant protection systems, ostensibly as a quality assurance mechanism for airbag and restraint (i.e., seatbelt) performance. Systems evolved largely organically, with different Tier 1 component suppliers and vehicle manufacturers (i.e., OEMS) developing systems to manage the deployment of airbags and the operation and performance of other vehicle safety systems.

In the absence of mandatory regulations and given the proprietary use of EDR data by vehicle manufacturers, multiple EDR systems emerged. Nonetheless, the passage of US Federal Regulation 49 CFR Part 563,[28] established by the NHTSA on 28 August 2006 outlined:

> '...uniform requirements for the accuracy, collection, storage, survivability, and **retrievability** of onboard motor vehicle crash event data in passenger cars and other light vehicles equipped with event data recorders (EDRs).' (p. 50998)

As noted previously, the US Regulation governs the specifications of voluntarily provided EDRs. The US Regulation did not — and still does not — mandate EDR fitment due to the high voluntary fitment rate but the text of the *Rule* stated that any slowing of fitment would open the prospect of a future mandate. By specifying a minimum dataset in a standardized format, NHTSA stated that the value of EDR data could be maximised by its use in (improving) crash reconstructions, as well as enabling eCALL (crash notification) and other telematic services. Manufacturers were free to add additional data points beyond that specified by the Regulation as they saw fit.

With respect to retrievability, the US Regulation required 'vehicle manufacturers to ensure the commercial availability of the tools necessary to enable crash investigators to retrieve data from the EDR' (p. 5098). In practice, this meant that 'vehicle manufacturers have to submit non-proprietary technical information sufficient to enable third parties to manufacture a device capable of accessing, interpreting, and converting the data stored in the EDR.' (p.5100). Further, the *Rule* states that:

> In order to ensure the retrievability of EDR data, each vehicle manufacturer that installs EDRs must ensure by licensing agreement or other means that the necessary tool(s) are commercially available for downloading the required EDR data. The tool must be commercially available not later than 90 days after the first sale of the vehicle for purposes other than resale'. (p 51001)

Stipulation of this was requirement was critical, the benefit of which is seen in the universal coverage of vehicle models sold in the United States supported by crash data retrieval systems; this is in stark contrast to the scenario in Australia where the number of supported vehicle models is very low.

While neither the UN R 160 (light vehicles) nor UN R 169 (heavy vehicles) makes mention of retrievability requirements, EU Delegated Regulations that act to give effect to the GSR II requirement do (i.e., light vehicles: EU 2022/545; heavy vehicles: EU *2024/2220*) [see Section 3.2.2]. This is an important example for Australia to follow.

It is clear then that an integral part of any national EDR mandate is the inclusion of a requirement that requires manufacturers to provide the specifications required for the download of interpretable EDR data to commercial EDR data retrieval kit providers. Based on the historical experience of Australia, any failure to include such a requirement will leave manufacturers free to continue to avoid providing access to interpretable EDR data via commercial systems, such as the Bosch CDR system.

[28] NHTSA (2006). Event Data Recorders, 49 CFR Part 563. Federal Register, Vol. 71, No. 166 (Monday, August 28, 2006) (71 FR 50998). Rules and Regulations.

3.3.2 ACCESSING EDR STORED DATA: PRIVACY LAWS

3.3.2.1 Australia

Two important issues concerning stored EDR data is a) ownership and b) access. Addressing both is important to ensure acceptability of EDR technology by the public. That the present EDR systems cannot be used to track drivers or provide access to video or voice data is important; if that were the case provisions of the *Surveillance Act 1999 (Cth)* might also apply (plus similar State/Territory legislation), along with the *Privacy Act 1986 (Cth)*. This will likely need to be addressed for DSSAD systems and as more ADAS systems become incorporated into the EDR, including the storage of video footage.

To the understanding of the *Report* authors, Australia does not have any legislation that includes specific mention of EDR ownership or access. It is accepted however that as the EDR is part of the vehicle then ownership of that vehicle component and the information the EDR contains rests with the purchaser and registered (nominated) owner of the vehicle. By extension, consent of the registered owner of the vehicle would be required to access the vehicle to then obtain the data.

Provisions concerning specification of the registered vehicle owner is covered by State and Territory Acts of Parliament and other relevant *Regulations* administered by the road authority. For instance, in Victoria the registered operator is defined by Regulation 13 of the *Road Safety (Vehicles) Regulations 2009* (Vic), while evidence of vehicle title sits under Section 9 of the *Road Safety Act 1986* (Vic); vehicles are registered through VicRoads as the relevant State government statutory authority.

In addition to provisions relating to vehicle ownership playing a role in accessing EDR data, provisions of the *Privacy Act 1986 (Cth)* and relevant State and Territory Acts[29] concerning health records are also relevant if person-related data is collected, used and/or disclosed in the process of accessing (including using) EDR data. For instance, depending on the circumstances, if health data was used to identify the injured person and/or their injuries, in Victoria the *Health Records Act 2001 (and associated Health Privacy Principles)* would apply.

While there are provisions under vehicle insurance policies, claims through statutory third-party insurers (CTP), and police powers to access vehicle information (including EDR data) and crash data, the conduct of research accessing and using EDR data would require vehicle owner consent as well as driver consent if different, as the data relates to that persons crash event. EDR data collected by police in the course of a crash investigation, for instance, and then used for the purposes of research would also require approval from relevant human research ethics committees and research governance bodies as relevant, but not necessarily the vehicle owner and driver as this may fall under a secondary use of data in scenarios where the data is deidentified.

While there is some complexity surrounding the use of EDR for research, it is the case that in all scenarios where EDR data is used for research approval from an Institutional Human Research Ethics Committee (HREC) at a University, government agency, and/or a Research Governance Committee would be required. This would ensure compliance with the NHMRC National Statement on Ethical Conduct in Human Research,[30] as well as other relevant legislation.

3.3.2.2 Europe

With regards to Europe, the General Data Protection Regulation 2016/679 (GDPR) plays an important role in the protection of personal data. Neither the UN Regulations nor the EU Delegated Regulations in respect of the General Safety Regulation (GSR) make any comment concerning ownership or use of EDR data, although the Regulation is clear on not identifying the vehicle driver in any of data stored or downloaded. One might expect that as the EDR is part of the vehicle ownership of EDR data rests with the registered vehicle owner, unless alternative ownership or access rights to that data is consented to at the time of purchase in the sale of contract. In Australia this is common and is referred to as a 'notice and consent' model.

[29] See LawLex Premium for State and Territory legislation. Includes Health Records (Privacy and Access) Acts and derivatives in each jurisdiction relating to health; also, Privacy and Data Protection Acts and Surveillance Device Acts.

[30] National Statement on Ethical Conduct in Human Research.

3.3.2.3 United States

Federal laws

The example of the United States in relation to EDR data ownership and privacy is important to consider. The US *Driver Privacy Act 2015*[31] includes specific provisions concerning the ownership and use of EDR data as defined by Section 563.5 of title 49, Code of Federal Regulations (49 C.F.R. § 563.3). Key provisions are:

- Ownership: Data retained by an EDR is the property of the owner, or, in the case of a leased vehicle, the lessee of the motor vehicle in which the event data recorder is installed
- Privacy: Data cannot be accessed by a person other than an owner or lessee of the motor vehicle in which the EDR is installed unless:

(1) "a court or other judicial or administrative authority having jurisdiction (A) authorizes the retrieval of the data; and (B) to the extent that there is retrieved data, the data is subject to the standards for admission into evidence required by that court or other administrative authority; [Court order]

(2) an owner or a lessee of the motor vehicle provides written, electronic, or recorded audio **consent** to the retrieval of the data for any purpose, including the purpose of diagnosing, servicing, or repairing the motor vehicle, or by agreeing to a subscription that describes how data will be retrieved and used; [consent is given by the owner/lessee];

(3) the data is retrieved pursuant to an investigation or inspection authorized under section 1131(a) or 30166 of title 49, United States Code, and the personally identifiable information of an owner or a lessee of the vehicle and the vehicle identification number is not disclosed in connection with the retrieved data, except that the vehicle identification number may be disclosed to the certifying manufacturer; [this facilitates investigations/inspections authorised by Federal law];

(4) the data is retrieved for the purpose of determining the need for, or facilitating, emergency medical response in response to a motor vehicle crash; [this facilitates eCALL/AACN systems].

(5) the data is retrieved for traffic safety research, and the personally identifiable information of an owner or a lessee of the vehicle and the vehicle identification number is not disclosed in connection with the retrieved data." [this falls into completely deidentified data].

As the *Act* specifically references EDR technology covered under 49 C.F.R. § 563, data from other vehicle systems are not covered by the US *Driver Privacy Act 2015*.

State laws (including Courts)[32] [33]

A number (17) of State legislatures have passed specific requirements in relation to EDR data access.[34] These State Statutes reinforce provisions that the consent of the owner is required, subject to exceptions (e.g., Court Order), for the EDR data to be downloaded. For instance, Oregon have legislated that data on the EDR does not become property of the insurer solely because they succeed in ownership of a vehicle as a result of a crash (O.R.S. § 105.932) and that all owners must consent to retrieve of use the EDR data (O.R.S. § 105.928). The State of Virigina, among others, has similar laws.

Courts have also made similar determinations concerning ownership, including in Florida, Tennessee, and Missouri. For example, in the State of Missouri an appellate court found that the EDR data is owned by the

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[31] 129 STAT. 1312 PUBLIC LAW 114–94—DEC. 4, 2015, ''Fixing America's Surface Transportation Act'' (FAST Act). H.R.22 - FAST Act114th Congress (2015-2016), Link.

[32] US Courts accept EDR data, with 340 cases seen where EDR data was validation for use. One such instance was in a case of manslaughter where the EDR data showed that the defendant was exceeding the speed limit (Chavis v. Commonwealth, No. 1029-16-2, 2017 Va. App. LEXIS 175 (Va. Ct. App. July 18, 2017).Another example is Commonwealth v. Zimmermann, the defendant, charged with motor vehicle homicide arising out of the death of her passenger in a single-vehicle accident, claimed that her speed was only between twenty to thirty miles per hour. The Zimmermann Court, however, found that an officer's affidavit from his accident reconstruction efforts provided sufficient probable cause to issue a warrant for the vehicle's EDR, which recorded that in the five seconds before the accident, the defendant's vehicle was traveling at a speed of fifty-eight miles per hour. Like other electronic devices belonging to a defendant, in Massachusetts it requires a search warrant

[33] Westlaw US & International

[34] https://www.ncsl.org/transportation/traffic-safety-legislation-database. States include Arkansas, California, Colorado, Connecticut, Delaware, Maine, Montana, Nevada, New Hampshire, New Jersey, New York, North Dakota, Oregon, Texas, Utah, Virginia, and Washington.

vehicle owner and cannot be accessed without the drivers' consent (*State v. West*, 548 S.W. 3d 406 (Mo. Ct. App 2018).

3.3.2.4 Comment

This section highlights the value of clarity concerning EDR data ownership, privacy and access rights. The US arguably provides a close-to best-practice model in relation to EDR data ownership, consent and exemption provisions. Any future moves to mandate the fitment of EDR data in Australia would ideally be accompanied by additions to relevant legislation to explicitly identify of EDR data ownership, access rights, and data protection requirements. This clarity would likely give confidence to vehicle owners, whilst at the same time giving researchers and other end users confidence in accessing EDR data. Furthermore, data sharing provisions for the purposes of eCALL is most likely to be necessary given that vehicle related data may be sent to third-party (crash reporting) services in the event of a crash.

3.4 TECHNICAL REQUIREMENTS TO ACCESS EDR DATA AND COVERAGE IN AUSTRALIA

This section documents the technical requirements to access EDR data for passenger vehicles and heavy vehicles, including equipment and access costs. This provides the basis for understanding the current situation with regard to vehicle models available in Australia where EDR data can be downloaded and interpreted. Using this information, combined with crash data, it is then possible to determine the number of crash-involved vehicles where EDR data is currently accessible. This represents an important input in determining whether mandating the fitment of EDRs through the ADR system in Australia is required.

3.4.1 ACCESSING EDR DATA: VEHICLE COVERAGE IN AUSTRALIA AND RETRIEVAL TOOL COSTS

This section documents the accessibility of EDR data for vehicles sold in Australia. There are currently three passenger vehicle EDR data retrieval systems, these being the:

1. Bosch CDR system.
2. GIT Hyundai / Kia system.
3. Tesla system.

The vehicle models these systems cover is outlined below.

From a technical standpoint, it needs to be understood that to access the EDR data a valid vehicle VIN must be entered. In entering into licensing agreements with commercial providers of EDR Crash Data Retrieval (CDR) systems, manufacturers must provide all necessary device specifications, including VIN specifications and the full range of VINs for each vehicle model sold in specific markets. Without these details from manufacturers, it is not possible for providers of EDR retrieval systems to support the download and interpretation of EDR data.

3.4.1.1 Bosch CDR system.

The current software release of the Bosch CDR system (24.2) includes coverage of 5,712 vehicle models based on manufacturer, model, and model year. Table 3.2 presents the number of vehicle models with EDR read coverage by the market where the vehicle is sold.

At present there is download support (i.e., coverage) for 1,533 vehicle model year vehicles sold in Australia, noting some vehicle models are also sold in other markets. Holden (GM) and Toyota / Lexus have long supported the Bosch CDR system for vehicle models sold in Australia. A number of Subaru models have also been supported but for only select model years, as seen in Table 3.2. A significant number of recent model year vehicles (i.e., since 2018 & 2020) have been added to the Bosch system even though the same models were sold in Australia earlier than those dates. Whether manufacturers have been motivated by UN R 160 to provide EDR access specifications via licensing agreements with Bosch is unknown.

With the exception of Holden (i.e., General Motors) (since 2007) and Toyota (since 2000) vehicle models, the ability to read EDR data for vehicles sold in Australia is low. While Holden and Toyota vehicle sales have traditionally represented a significant proportion of all vehicles sold in Australia — and by extension involved in crashes — the coverage for non-Holden and non-Toyota vehicles before 2017 is almost non-existent.

Significant gaps in EDR access coverage for vehicles sold in Australia remain as evidenced by the following:

1. Ford vehicles sold in Australia have no EDR data download coverage (with the exception of the Ford Mondeo for 2015/16 only). As a contrast, EDR data retrieval is supported in the same vehicle models sold in the US and other markets. Exemplar models in this category include the Ford Escape, Focus, F150, Transit, F150, and the Mustang. The top selling Ford Falcon (for many years) has no EDR download coverage via the Bosch Crash Data Retrieval (CDR) (or other) system; this is despite having a frontal drivers airbag fitted as standard equipment in the EF model Falcon introduced in August 1994 (note: front passenger airbag was an option). Recent vehicle sales data shows that in the 2024 calendar year, 100,170 Ford vehicles were sold in Australia, equating to 8.2% of all sales and placing Ford as the second highest selling vehicle manufacturer in the country (see Table 3.4).[35] [36]

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[35] https://www.fcai.com.au/new-vehicle-sales-reach-one-million-in-2024/

[36] Newstead, S., Rampollard, C., Budd, L., Keall, M., & Cameron, M. (2024). Vehicle safety ratings estimated from police-reported crash data: 2024 Evaluation - Australian and New Zealand crashes during 1987-2022 (MUARC Report No. 371). (Version 2). Monash University. https://doi.org/10.26180/27263391

TABLE 3.2 BOSCH CRASH DATA RETRIEVAL (CDR® V.24.2) SUPPORT FOR VEHICLES SOLD IN COUNTRIES AND GLOBAL MARKETS[37]

MARKET (EDR COVERAGE, WHERE SOLD)	NUMBER OF VEHICLE MODELS (MANUFACTURER, MODEL, YEAR)	MODELS INCLUDED (SELECT MODELS WHERE MANUFACTURER ONLY NOTED)
COVERAGE IF SOLD IN AUSTRALIA		
All markets	199	BMW, MINI, Rolls Royce (from 2019) Subaru Forrester (2021)
All markets sold	60	Cupra (all, from 2018); Seat (all, from 2017)
Australia	246	Subaru (from 2015); Toyota Yaris (2021); Ford Mondeo (2015, 2016); **Holden / HSV (from 2007)**; Opel (Astra, Insignia, 2013, 2014)
Japan / Australia	3	Subaru Exgia (2013, 2014, 2015)
NAFTA/Australia/NZ	4	Chevrolet Camaro (2020, 2021); Chevrolet Silverado (2020, 2021);
US / Australia / Other	6	Subaru Outback (2013, 2014); Subaru Legacy (2013, 2014), Subaru Forester (2019, 2020)
Where sold	1,015	Bentley (from 2019); Audi (from 2018, not Q5); Chrysler (from 2006); Dodge (from 2005); Fiat (from 2017); Jeep (from 2006); Lancia (2012-2015); **Lexus (from 2000);** Mitsubishi (from 2007); Polestar (from 2019); Porsche (from 2019); RAM (from 2010); Scion (2003-2016); Subaru (from 2012); **Toyota (from 2000);** VW (from 2018); Volvo (from 2014); Skoda (Kodiaq, from 2020)
Sub-total models	1,533	
MODELS OUTSIDE AUSTRALIA ONLY		
Canada	16	
China / Europe / NAFTA / South Korea	593	
Europe	95	
Indonesia, Japan, Philippines	21	
Japan	67	
Japan / Europe / Malaysia	10	
Korea	2	Ford Ranger (2017, 2018)
Malaysia	5	
Mexico	1	
NAFTA (and other markets)	1,483	
North America, Europe, China	1	
South Korea	53	
Turkey	2	
US, including other markets (excl. Australia)	1,830	
Sub-total	*4,179*	
TOTAL MODELS COVERED	5,712	

[37] https://cdr.boschdiagnostics.com/cdr/cdr-v242-system-software

2. Manufacturers with vehicle models sold in the Australian market but with no CDR / EDR VIN coverage include Alfa Romeo; Citroen; Daewoo; Dacia; Daihatsu; Fiat; Ferrari; Freightliner; GMC; Hummer; Infiniti; Isuzu; Jaguar; Land Rover; Maserati; Mazda; Mercedes; Nissan; Renault; Saab; smart.
3. Some manufacturers listed in Table 3.2 have specific models with Bosch CDR support but only for those sold in other markets (e.g., Skoda, VW). As an example, the Audi Q5 sold in Australia is not covered by the Bosch CDR software (v.24.2) despite being supported when sold in other markets.
4. Vehicles manufactured in China and sold in Australia are not supported by the Bosch CDR (e.g., BYD, Chery, Geely, GWM, LDV, Zeeker).

That this coverage gaps exist reinforces the need for jurisdictions, including Australia, to have specific legislation that requires manufacturers to facilitate EDR access by ensuring that *read* specifications are available to crash data retrieval tool providers for all vehicles. That the United States has comprehensive coverage of EDR data is likely to be due to the provisions of US CFR 49 563 that requires manufacturers to make available to commercial providers the necessary specifications to design systems to access EDR data. Australia has likely benefited from this provision, noting that the Bosch CDR software supports GM-Holden and Toyota vehicle models sold in Australia since 2007 and 2000 respectively.

Costs of the Bosch CDR system

The Bosch CDR system has been in use since the early 2000s. The Australian distributor of the Bosch CDR system is Bosch Diagnostics (https://cdr.boschdiagnostics.com/cdr/cdr-distributors). The Monash University Accident Research Centre (MUARC) and the Centre for Automotive Safety Research (CASR) at the University of Adelaide use the Bosch CDR system.

The Bosch CDR system supports the download of EDR data from the vehicle On-board Diagnostic (OBD) interface (per SAE J1962, *Diagnostic Connector*), and directly from the Airbag Control Module (ACM) using vehicle model specific cables (known as PCM cables). The components of the Bosch CDR system are as follows (costs in $USD, from Crash Data Group):

- Bosch 900 CDR kit / CDR-900-DLC (USD$ 5,900).
- Bosch CDR 500 FlexRay Adapter Kit (USD$ 2,900) (required only if control unit has *Flexray* communications protocol fitted).
- Bosch CDR ACM Adapter (USD$ 300).
- Bosch CDR DLC4 Adapter (including for Non-US/Canada vehicles) (4, include Toyota specific) (USD$ 75/each; total: USD$ 300).
- Bosch PCM Cables, for individual vehicle models at USD$ 285/each. There are 89 cables available, hence total cost is USD$ 25,365. Note: only a subset of cables is relevant to Australia.

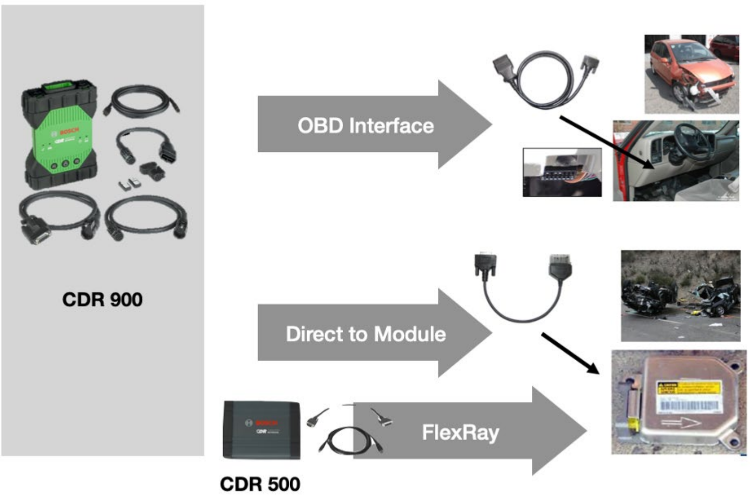


FIGURE 3.4 BOSCH CDR SYSTEM AND CONNECTION OPTIONS[38]

[38] https://www.asdarts.com/de/bosch-cdr

MONASH University

For its crash investigation work MUARC has purchased (2014 $ values):

- Individual vehicle model cables (AUD$ 158 each).
- Adaptors (AUD$ 53).
- Crash Data Retrieval (CDR) system cables (AUD$ 218).
- Controller Area Network (vehicle) interface module costing AUD$ 1,350.
- Rolling 12-month licence subscription fees (AUD$ 1,500).

As specific cables, and at times adaptors, are required for each vehicle model, the equipment costs to access EDR data is high.

The full hardware list is available here (Link). The current software version is Version 24.2, released on October 3, 2024 (Link).

Access to other vehicle modules through the Bosch CDR system

Using the Bosch CDR system and depending on the vehicle model, additional data can be accessed from the Forward Camera Module (FCM) (e.g., GM), the Powertrain Control Module (PCM), the Pedestrian Protection Module (PPM), the Rollover Sensor (ROS), and most recently the Driver Monitoring System Module (DCM) (e.g., Jeep [FCA/Stellantis group). To do so requires different cables including the Bosch CDR CANplus USB-to-Serial Cable, for instance.

These data fall outside of the scope of the current EDR regulations; however, it is worth noting that the data from these systems will be immensely valuable for use in the conduct of crash investigations and academic research moving forward.

Time-based estimates in accessing EDR data

In practical terms three options exist to download data from the ACU/EDR with each having different time implications. For the purpose of these three options, and in line with usual practice, the EDR data is obtained as part of a comprehensive vehicle and scene inspection. The reader is referred to Chapter 4 for insights into police and insurance-based forensic investigations. The time estimates to access and download the EDR data are consistent across police, insurance investigators, and research-based crash investigators.

Download options 1 and 2 are relatively straightforward as the vehicle is either undamaged or has at worst moderate damage but where the occupant compartment is intact and the data ports are intact and accessible.

- Download Option 1: ACU/EDR read in-situ, and the vehicle can be powered by internal vehicle systems. EDR data is obtained by connecting directly to the vehicle ODB-II (or relevant) interface. This may require exposure of the EDR by quick removal of an internal panel (i.e., clips in/out). The process from start to finish, including unpacking the relevant equipment and repacking as well as downloading the EDR data onto an external computer is estimated to be 30 minutes, including 10 minutes to directly access, read and view the downloaded data in pdf form. While the data can be quickly interpreted and used immediately, the data is integrated with all other vehicle and crash scene investigation as usual practice.
- Download Option 2: ACU/EDR read in-situ, but the vehicle cannot be powered by internal vehicle systems. An external power system must be fitted, otherwise the process is as per Option 1; hence time is estimated to be 40 minutes. Time-estimate: 30 minutes + 10 minutes for unpacking, packing, and re-packing of an external power source.
- Download option 3: ACU/EDR must be removed from vehicle and read directly on the desktop. This occurs when Option 2 is not viable for safety reasons and/or that the OBD-II interface is either damaged or not accessible due to vehicle crush. Once the ACU/EDR is obtained, the read-to-interpretation time is 10 minutes. Removal of the ACU/EDR may take 20-30 minutes (most usual) through to 45 minutes in a vehicle damaged vehicle, although in rare cases this physical removal of the EDR may not be possible due to the extent of vehicle crush and need to ensure the health and safety of crash investigators. Estimated total time: 40 to 55 minutes, including 'read time'.

Time estimates were used with the hourly pay schedules of relevant personnel. Estimated costs to acquire EDR data are as follows (2024): Option 1: Police/Research: $55; Insurance: $78; Option 2: Police/Research: $66; Insurance: $94; Option 3: Police/Research: $66-$101; Insurance: $94-$143. Cost savings associated through having access to EDR data and the reasons for this are presented in Chapter 4.

3.4.1.2 Global Information Technology (GIT) system: Hyundai and Kia vehicles

Global Information Technology (GIT) was established in 1997 as part of the Hyundai Motor Group.[39] [40] GIT has developed comprehensive diagnostics systems and offers Information and Communications Technology (ICT) solutions based on vehicle data, vehicle information, and computing software.

In 2013 GIT released the EDR 1.0 SW system to read EDR data from Hyundai and Kia vehicles.[41] This was in response to the NHTSA regulation 49 CFR 563 that required manufacturers to make EDR specification information available to commercial providers of EDR systems when the regulation took effect on September 1, 2012. For both Hyundai and Kia vehicles MY 2013 vehicles with a production date of 9/1/2012 or later sold in the United States are supported.[42]

On March 17, 2024, an updated EDR 2.0 SW system was released; this EDR download system supports vehicles manufactured from 2024 onwards.[43] [44] The EDR software also includes the ability to download ADAS system data through the *ADL Data Logger* menu. It is assumed that EDR 2.0 SW system supports Hyundai (including Genesis) and Kia vehicles sold in Australia, although this is not yet confirmed. There is presently no authorised distributor of the GIT EDR system in Australia. The GIT EDR 2.0 SW system is available for purchase in United States and in Europe / Middle East (authorised seller: https://www.asdarts.com/, located in Sasbach, Germany).

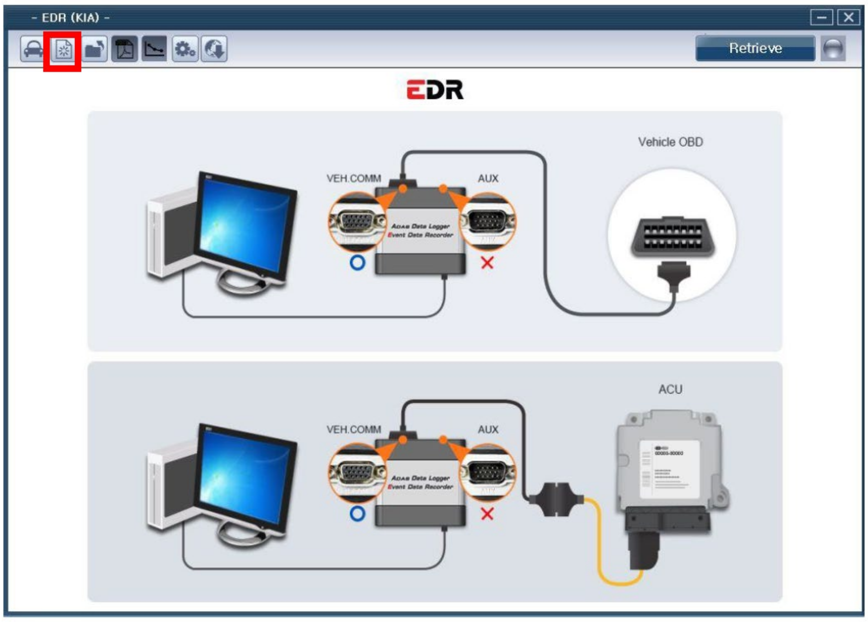


FIGURE 3.5 GIT KIA SYSTEM[45]

Components and Costs of the GIT Hyundai / Kia EDR 2.0 SW CDR system

Costs from the US authorised seller of the GIT system, *Crash Data Group* (https://crashdatagroup.com/, California, United States) were used.[46] Like the Bosch CDR system, multiple components are required including a Vehicle Communication Interface (VCI), ACU adaptors (Hyundai: 3; Kia: 5; USD$ 300/each), a DLC/OBD2 port connection cable for in-situ downloads, and vehicle model specific cables for direct-to-EDR connection (USD$ 300/each; 16 in total). The purchase of the EDR Tool Kit with software is $USD 9,200 plus $USD 1,400 for the CAN FD Communication Interface Module (CFCI) module. To purchase all components

[39] https://www.hyundaimotorgroup.com/group/CONT0000000000000708
[40] https://www.gitauto.com/eng/index
[41] Ruth, R. and Tsoi, A., Accuracy of Translations Obtained by 2013 GIT Tool on 2010-2012 Kia and Hyundai EDR Speed and Delta V Data in NCAP Tests. SAE Technical Paper 2014-01-0502, 2014. https://doi.org/10.4271/2014-01-0502.
[42] https://device.report/m/a081eee8ece4da631c3e15cc78ec35d9b9f4733cd68f23d814591f2ebf89b8f0.pdf
[43] https://support.gitauto.com/hc/en-gb/articles/19402621272857--KIA-EDR-User-Manual
[44] https://support.gitauto.com/hc/en-gb/articles/19402616276889--HYUNDAI-EDR-User-Manual
[45] https://support.gitauto.com/hc/en-gb/articles/19402621272857--KIA-EDR-User-Manual
[46] For a video on the GIT kit and data download, see: https://www.youtube.com/watch?v=pGvb9EXuaCw

separately the total cost is $USD 18,350, with a recurring 12-month software license fee payable for both the Kia and Hyundai systems (USD$ 825/each).

3.4.1.3 Tesla EDR

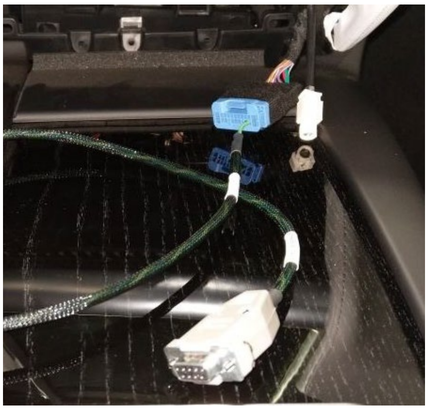
Tesla have implemented an EDR retrieval, read, and reporting process for its Model S, Model 3, Model X and Model Y vehicles manufactured as follows:

- Model S: from 26 February 2019 (3 cables, date dependent).
- Model 3: all dates (2 cables, date dependent).
- Model Y: all dates (1 cable).
- Model X: all dates (1 cable).

The EDR data for Tesla vehicles is stored in the Restraints Control Module (RCM). Tesla provide detailed information concerning its EDR systems (https://edr.tesla.com), inclusive of Tesla EDR User Guides (https://edr-eu.tesla.com/help).

The EDR data access protocol through Tesla is straightforward. Steps are as follows:

1. Acquire the necessary EDR hardware kit inclusive of the vehicle model cable plus a USB-to-CAN adapter. This hardware is purchased through suppliers (see below).
2. Using the *Tesla EDR Retrieval Program* (available for download, version 24.43.1, November 2024), retrieve the EDR data; this is done in one of two ways:[47]
    1) Using an In-Vehicle EDR Retrieval Cable to the communications port, with an adaptor to connect an external computer. This process requires the vehicle to provide power and the RCM connection to the CAN is intact.
    2) Direct connection to the vehicle RCM module.



1) In-vehicle connection

2) Direct connection to RCM

   Once connected to the EDR (via OBD2 port or directly to the RCM), the user 'Run[s] EDR Retrieval' and a *.edr file is generated.

3. To generate an EDR report (EMEA region end users), the user uploads the retrieved data (*.edr) directly to the Tesla website through the *Report Service*. This service is free. A pdf report is generated, which also includes the raw hexadecimal data at the end of the report.[48]

   It is interesting to note that to upload the retrieved data, the user must agree to the statement that:

   > By uploading EDR data, I certify that I have the **consent of the vehicle owner or leasee or otherwise have lawful authority** to submit this data and agree that Tesla may use the data for analytics, tool improvement, and accidentology research purposes subject to Tesla's Privacy Notice. (https://edr-eu.tesla.com/)

[47] Tesla. Model S EDR Data Retrieval Guide for Vehicles Built Through 2/25/2019. Link.

[48] Hexadecimal data is the way the original source data within the EDR is stored; this data is translated by the CDR tool software to generate an interpretable report that is provided as a pdf.

Of note is the statement concerning consent of the vehicle owner/lease and the use of the data by Tesla for its own purposes including accidentology research purposes.

Components and Costs of the Tesla EDR Kit

Telsa EDR hardware retrieval kits (systems) are available to purchase from the *Crash Data Group* (only within North America, https://crashdatagroup.com/collections/tesla-edr-tool; $USD 1,500) and from *asDARTS* for Europe, Middle East and North Africa (EMEA) and the Asia-Pacific markets (https://www.asdarts.com/de/tesla-edr; 1,400.00 € VAT Excluded). These two sites have useful information links concerning the Tesla EDR system including vehicle data connection and retrieval manuals.

The EDR Retrieval Hardware Kit for Tesla vehicles includes necessary in-vehicle cables, direct-to-module connection cables, the PCAN-USB adaptor and power supply.

3.4.1.4 Heavy Vehicle EDR systems (HVEDR)

This section provides a brief overview of HVEDR systems. In principle, the concept of the HVEDR is the same as for passenger vehicles. However, the technical implementation of HVEDRs differs from passenger vehicles; this is largely due to the role of engine management systems and diagnostic systems in fuel injected diesel engines. In addition, heavy vehicles traditionally did not have airbag systems fitted. Given the recent ratification of UN R 169, *Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles,* it is of value to provide an overview of HVEDR implementation, data, and access.

For an outstanding report on HVEDR, the reader is referred to: Transport Canada (2024). *Heavy vehicle event data recorders: best practices*. (published 25 October 2024). Link.

EDR architecture in heavy vehicles (including buses)

The implementation of HVEDR differs from passenger vehicles. Trip and event data is stored in the Electronic Control Module (ECM) (or Unit, ECU) and is part of the heavy vehicle diagnostics system. Manufacturers added a trip/event data recording function early in the 1990s. HVEDR systems (data recording systems) have evolved since that time and are frequently referred to as Electronic Onboard Recorders (EOBRs).[49]

Following the CAN (Controller Area Network) protocol, data is drawn from multiple sensors and modules from across the vehicle, including the vehicle speed sensor (VSS) [measures wheel rotation and may not be actual forward vehicle speed), the brake position sensor, and the throttle position sensor. The CAN network allows data to be used simultaneously by multiple modules.

The HVEDR, as with passenger vehicles, is a data card stored within these modules. Aside from the Engine Control Module (ECM), HVEDR data may be contained within the Powertrain Control Module (PCM), the Body Control Module (BCM), and an Airbag Control Module (ACM) where airbags are fitted.

HVEDR data includes:

- Incident records triggered by hard braking, rapid acceleration/deceleration, hard braking. This data reflects a passenger vehicle EDR data record and includes, for example vehicle speed, engine RPM, engine load, throttle, braking, and cruise control.
- Last stop data, containing vehicle sensor data of 1.5 minutes leading up to trip that ended in 0 mph (overwritten on next vehicle movement).
- Engine use.
- Trip reports.
- Stability control.
- Crash acceleration data.
- Vehicle diagnostic codes.

Understanding the engine manufacturers is important as implementation – and hence HVEDR systems, differs. Common engine manufacturers and modules where HVEDR data is found include:

- Caterpillar (PEEC and ADEM systems).
- Cummins Diesel (CLECT and IS systems).

[49] Crash data forensics. Truck Events Data Recorders Explained. https://www.crashforensics.com/truckdatarecorders.cfm

- Daimler includes Detroit Diesel and Mercedes Benz (DDEC 1 through to DDEC 10; HVEDR included in VCU and VRDU module includes ADAS system data) (includes Freightliner, Sterling, Western Star vehicles).
- Navistar / International Advanced Diesel engines (Maxxforce system).
- Mack and Volvo (VMAC systems) (Volvo Group) (engines differ by brand and use Cummins, Detroit Diesel, Mack, as well as Volvo and Mack engines).
- Paccar (MX system) (brands: Kenworth, Peterbuilt, DAF).
- Isuzu engines.

Data is also stored and/or obtained from braking systems, including the Bendix ACOM brake controller (braking) system, as well as Haldex (braking), and WABCO (braking) systems.

Accessing HVEDR data in heavy vehicles (including buses)

As noted, access to EDR and related data in heavy vehicles is normally achieved via the vehicle diagnostic systems.

Synercon Technologies[50] is a key hardware and software tool provider to access ECM / HVEDR data. The Synercon Smart Sensor Simulator 2 (SS2) unit (USD$ 5850) is used to connect to an ECU/ECM via the 6 or 9-PIN port Deutsch DLC port for in-vehicle vehicle download. For direct connection to the ECU / ECU, the Forensic Link Adaptor is used. Hardware connections (cables) are available for all brands. An interface software system is available for the Synercon SS2 system. For direct connections to the ECM/EDU the Synercon TruckCRYPT program is used, however Daimler and Cummins Diesel have their own software available.

Other manufacturer specific kits include the Volvo HVEDR specific *VOCOM II – Heavy-Duty Vehicle Diagnostics Kit (*USD$ 1200) / PTT TechTool Software. Likewise, the Scania VC 14 (Trucks and Buses) and IVECO vehicle communication interface (VCI) kits combined with the Unified Diagnostic Tool software can be used to download data from trucks, light-duty, and heavy-duty vehicles.

For these diagnostic systems to work, a connection to the vehicle ECM (or relevant module) is required. Diesel engines are generally fitted with 6-pin or 9-pin[51] SAE J1939 (2016 and newer) Deutsch DLC (downloadable content) system that enables connection to the vehicle CAN network and associated modules (Link). This is the critical link to the vehicle Controller Area Network (can) Channels via the OBD2 port. Systems differ across manufacturers, although converter / adaptor cables are available (~USD $55-100); brands include Dg Technologies, Noregon, Bosch, TEXA, Nexiq, Drew Tech, and Grandview.[52] These brands also produce and sell vehicle diagnostic systems.

For basic engine and other system diagnostics, scan tools are available. These include handheld equipment (Link 1) (Link 2) including a Smartphone (Link), and Tablet-based full diagnostic systems (Link). Diagnostic system tools range in price from USD$ 750 to USD$ 7,500. Specific Anti-lock braking system (ABS) data module download tools are also available.

Commercial HVEDR data providers are active globally. Indicative costs to access HVEDR data online at a commercial provider are USD$ 300 per hour for data imaging onsite (plus travel, equipment costs, benchtop imaging (USD$ 2,375); consultation and court appearances with associated legal expenses are both $USD 300/hour.

Telematics data in heavy vehicles (including buses)

Another valuable source of data relating to trucks is telematics data. Telematics devices (including wireless systems) are frequently used to manage workflow and monitor vehicle metrics and driver performance. These data can also prove invaluable when investigating crashes involving heavy vehicles, including buses.

Moving forward with HVEDR data

For information purposes: UN R 169 includes uniform provisions for the fitment of HVEDR in M2, M3, N2 and N3 vehicles. It has been suggested in the WP.29 EDR/DSSAD IWG (Meeting #24) that UN R 160 could be used for EDR type approval for vehicles up to 12 tonnes. The key question is whether the EDR event trigger is

[50] Synercon Technologies, https://synercontechnologies.com/sss2/

[51] Diesel Laptops: Connectors Explained. https://www.diesellaptops.com/blogs/news/the-new-green-9-pin-j1939-connectors-explained.

[52] https://www.diesellaptops.com/

appropriate for vehicles of considerably greater mass than 3.5 tonnes, to which UN R 160 applies. Data presented at the IWG do not appear to support the use of UN R 160 event triggers for these larger mass vehicles.

3.4.2 ACCESSING EDR DATA: CURRENT STATUS AS REFLECTED IN CRASH AND NEW VEHICLE SALES DATA

When considering the need for adoption of an EDR mandate it is necessary to examine the fitment of EDR systems and data access for vehicles sold in Australia.

The discussion of the three available EDR access systems (Bosch, GIT, Tesla) as they relate to passenger vehicles and heavy vehicles (HVEDR) in the previous section (3.2) outlines the technical requirements to access the data.

With respect to passenger vehicles, the EDR data download support for vehicle models sold in Australia is low. This is despite the same vehicle models having EDR download coverage when sold elsewhere. The key issue, it appears, is the lack of a legislative requirement for manufacturers to make the EDR read specifications available to commercial providers of CDR kits for vehicle models sold in Australia, as is the case in the United States due to US Regulation 49 CFR 563 and now in the EU. For these vehicles the Bosch CDR system does not accept the VIN number of vehicles sold in Australia.

The recent addition of Tesla and the Hyundai – KIA GIT EDR access and download system is a positive step, although the applicability of the Hyundai-KIA GIT system to vehicles (only for MY 2024 onwards) sold in Australia remains unknown.

With respect to HVEDR data access, it is *assumed* that ECM/ECU HVEDR data is available without VIN restriction due to the critical role of ECM/ECU access by vehicle technicians. Whether this changes over time with the passage of UN R 169 and the development of HVEDR specific systems remains unknown.

3.4.2.1 Passenger vehicle EDR data access

This section seeks to document the number of passenger vehicles involved in crashes in Australia that are fitted with an EDR that can be downloaded and read.

The 2024 MUARC *Used Car Safety Rating (UCSR)* report was used to identify the number of unique vehicle models involved in crashes in NSW, Queensland, Western Australia and South Australia in the 2000 – 2024 period.[53] The vehicle model year was limited to MY 2000 and newer for the following reasons:

- From MY 2000 all Toyota vehicles sold in Australia were supported by the Bosch CDR system.
- The requirement that all new model MA category vehicles to meet the requirements of ADR 73 (UN R 94; frontal offset) from 1 January 2000 (https://www.legislation.gov.au/F2005L03990/latest/text).
- The universal fitment of at least frontal impact driver airbags in vehicles at this time, hence, these vehicles would have fitted an ACU/EDR. Whilst the fitment of airbags is not mandatory, meeting the performance-based standards of ADR 69 (full frontal; 1995), ADR 72 (UN R 95, side impact; 1999), and ADR 73 (UN R 94, frontal offset; 2000), as well as the ANCAP star-rating requirements meant that manufacturers installed *at least* a front driver airbag as standard equipment before later adding side impact airbags and head protecting curtain airbags.[54]

A total of 845 Model Year (MY) 2000 and later vehicles were identified in the UCSR dataset (Table 3.3). Of these, 209 (24.7%) had an ACU/EDR that supported by the Bosch CDR tool (v.24.2, October 3, 2024);[55] four Tesla vehicle models that are covered by the Tesla CDR system were also seen (0.5%) [25.2% total, 213 of 845]. Combined, these 213 vehicle models represented 30.2% of all MY 2000 and later vehicles involved in crashes and 28.7% of fatality and serious (FSI) crashes in the 2000-2022 period.

53 Newstead, S., Rampollard, C., Budd, L., Keall, M., & Cameron, M. (2024). Vehicle safety ratings estimated from police-reported crash data: 2024 Evaluation - Australian and New Zealand crashes during 1987-2022 (MUARC Report No. 371). (Version 2). Monash University. https://doi.org/10.26180/27263391 (released 30 October 2024).

54 ADR 85, Pole Side Impact, has played a more recent role in the addition of rear seat head protecting airbags.

55 Bosch released CDR Tool Software Version 24.2 (supported vehicles). https://cdr.boschdiagnostics.com/cdr/cdr-v242-system-software

TABLE 3.3 NUMBER OF PASSENGER VEHICLE MODELS MY 2000 ONWARDS INVOLVED IN CRASHES WITH SUPPORTED EDR RETRIEVAL† IN NSW, QLD, WA, & SA (2000-2022), UCSR DATA[56]

PARAMETER	NUMBER OF VEHICLE MODELS		UNINJURED DRIVERS (VEHICLES)		INJURED DRIVERS (INVOLVED VEHICLES)		TOTAL DRIVERS (INVOLVED VEHICLES)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Year 2000 and newer[57]	845	100%	863,677	100%	207,602	100%	1,071,279	100%
Bosch coverage	209	24.7%	263,247	30.48%	59,627	28.72%	322,871	30.14%
Tesla coverage	4	0.5%	164	0.02%	21	0.01%	185	0.02%
EDR coverage	**213**	**25.2%**	**263,411**	**30.50%**	**59,648**	**28.73%**	**323,056**	**30.16%**

† Note: The Hyundai – KIA GIT system was excluded as the EDR 2.0 SW system was released on March 17, 2024, and is appliable to vehicle models sold from 2024.

While the above data can be used as a robust estimate of the proportion of passenger vehicles involved in crashes that can be expected to have accessible EDR data, analysis of single (or multiple) years of crash data can also be informative. Using year 2022 crash data from NSW (see Appendix 7), 94.6% of passenger vehicles involved in fatality and serious injury crashes were MY 2000+ vehicles (22nd full year/life; 23rd year of driving) (Table 7.2). For crashes of all severities, this vehicle age range captured 96.1% of passenger car vehicles involved in crashes (Table 7.7).

Using these inputs, it can be estimated that:

- 26.98% (i.e., 0.2873 * 0.946) of passenger vehicles involved in FSI crashes would have a readable EDR.
- 28.98%; 0.3016 * 0.961 of passenger vehicles involved in all crashes would have a readable EDR.

That slightly more than 70% of vehicles have an ACU/EDR fitted that cannot be accessed and read highlights the need for legislative requirements to force manufacturers to either share EDR specification information with commercial providers of crash data retrieval systems or to provide such systems themselves for purchase as done by Tesla and Hyundai.

To further demonstrate the impact of the inability to download and read ACU/EDR data, the TAC-funded MUARC led *Enhanced Crash Investigation Study (ECIS)* sought to use EDR as an analysis tool to supplement the in-depth investigation of serious injury crashes in Victoria. This research program enrolled 400 crash-involved drivers admitted to The Alfred Hospital or the Royal Melbourne Hospital. The study enrolment period commenced in June 2014 and ran through to December 2016. Drivers consented to be enrolled in the study. Vehicle owners, if different to the driver, gave consent for their vehicle to be inspected. Provision of informed consent included access to vehicle EDR data. In some instances, the drivers' Next-of-Kin provided consent to enrol the driver to the study; this occurred in instances where the driver was too severely injured to provide informed consent themselves.

Of the 400 drivers enrolled to the ECIS study, 296 (of the 400) were in vehicles were fitted with an ACU/EDR. However, only 18.5% (n = 55) of these vehicles had an EDR supported by the Bosch CDR system (see Appendix B [p.157] of ECIS Report 1[58]). This represented a significant loss of data to the ECIS program. While discussed further in Chapter 4 in relation to Police-led crash investigations, to access the EDR data from manufacturers overseas is cost prohibitive (~€4,000, AUD $6,477 per EDR unit) for academic-led research. We do note,

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[56] Newstead, S., Rampollard, C., Budd, L., Keall, M., & Cameron, M. (2024). Vehicle safety ratings estimated from police-reported crash data: 2024 Evaluation - Australian and New Zealand crashes during 1987-2022 (MUARC Report No. 371). (Version 2). Monash University. https://doi.org/10.26180/27263391 (released 30 October 2024).

[57] Analysis was limited to MY 2000 and newer vehicles. Noting the long span of years included in the UCSR dataset (i.e., 1987 – 2022), 1250 vehicle models are included. The analysis conducted here limited this to model year 2000 onwards vehicles to a) coincide with Toyota Bosch CDR covered b) the requirement of on all new model MA category vehicles to meet the requirements of ADR 73 (UN R 94; frontal offset) from 1 January 2000 (https://www.legislation.gov.au/F2005L03990/latest/text) , and c) the universal fitment of at least frontal impact driver airbags at this time.

[58] Fitzharris, M., Lenné, M., Corben, B., Pok Arundell, T., Peiris, A., Liu, S., Stephens, A. N., Fitzgerald, M., Judson, R., Bowman, D., Gabler, H., Morris, A., & Tingvall, C. (2020). Overview and analysis of serious injury crashes – crash types, injury outcomes and contributing factors, ECIS Report 1 (MUARC Report 343). Monash University. https://doi.org/10.26180/23305325

however, that the EDR data obtained was used to validate the crash reconstruction process for all other crashes (see Chapter 4, *Uses in Research)*.

3.4.2.2 New Vehicle Sales Data

New Car Sales Data for the 2024 calendar year was used to examine the number and proportion of new vehicles fitted with an EDR that can be downloaded using the available retrieval tools.[59] [57] As shown in Table 3.4, only 57.3% of new vehicles sold in Australia (n = 697,368; 24 of 53 manufacturers [45.3%]) in the 2024 calendar year had a readable EDR. That is, the EDR module fitted into 42.7% of vehicles are not supported by the currently available EDR data retrieval tools.

While vehicles manufactured in China have become increasingly popular (e.g., BYD, Chery, GWM), none of the EDR systems described support the download of EDR data from these vehicle manufacturers.

It is important to note that CDR software systems can be updated to include previous model year vehicles. This is because it is the software that validates the VIN entered by the user when retrieving the store EDR data.

TABLE 3.4 2024 CALENDAR YEAR NEW VEHICLE SALES[60] AND EDR RETRIEVAL (READ) STATUS

MANUFACTURER	NUMBER SOLD (2024)	SHARE (2024)	EDR DATA CAN BE RETRIEVED (SYSTEM)
1. Toyota	241,296	19.8%	**Yes (Bosch)**
2. Ford	100,170	8.2%	No
3. Mazda	95,987	7.9%	No
4. Kia	81,787	6.7%	**Yes (GIT)***
5. Mitsubishi	74,547	6.1%	**Yes (Bosch)**
6. Hyundai	71,664	5.9%	**Yes (GIT)***
7. MG	50,592	4.2%	No
8. Isuzu Ute	48,172	4.0%	No
9. Nissan	45,284	3.7%	No
10. GWM	42,782	3.5%	No
11. Subaru	40,604	3.3%	**Yes (from MY differs)**
12. Tesla	38,347	3.1%	**Yes (Tesla)***
13. Volkswagen	36,480	3.0%	**Yes (from 2018)**
14. BMW	26,341	2.2%	**Yes (from 2019)**
15. Mercedes-Benz	24,831	2.0%	No
16. Suzuki	21,278	1.7%	No
17. BYD	20,458	1.7%	No
18. LDV	16,022	1.3%	No
19. Audi	15,333	1.3%	**Yes (from 2018, not Q5)**
20. Honda	14,092	1.2%	No
Subtotal: Top 20	1,106,067	90.8%	-
Vehicles outside Top 20	111,597	9.2%	33 manufacturers, 15 with EDR support (4.7% sales)
All vehicles sold in period	1,217,664	100%	

Note: * Unconfirmed if Australian vehicle VIN are valid (assumed yes).

Note: Holden (which has had universal EDR support on Australian model vehicles since 2007) are no longer in production.

[59] FCAI. New record but outlook remains tough (6 January 2025). https://www.fcai.com.au/new-record-but-outlook-remains-tough/

[60] VFACTS 2024: New vehicle sales hit record high, but slump expected soon (6 January 2025). Source: https://www.carexpert.com.au/car-news/vfacts-2024-new-vehicle-sales-hit-record-high-but-slump-expected-soon

3.5 CONCLUDING COMMENT

This *Chapter* set out to document the current regulatory environment pertaining to EDR technology for passenger vehicles and heavy vehicles, including buses. In describing these regulations and the data collected by EDR devices, the value of the data as an objective record of the vehicle metrics and pre-crash driver behaviour can be seen. It is evident that the regulatory environment pertaining to EDR technology is highly complex.

The UN Regulation 160 (including 01 Amendments) and UN Regulation 169 as they apply to passenger cars and heavy-duty vehicles, respectively, include important requirements for vehicle data to be collected and stored (see Appendix 6 for definitions). Of note the EU has implemented both UN Regulations recently, consistent with the EU *General Safety Regulation*. This was done through enabling EU Delegated Regulations. Worth noting is that like the US Regulation, the EU stipulated that manufacturers must make EDR data accessible for vehicles sold in that market.

The United States EDR regulation, although not mandatory, specifies mandatory requirements on manufacturers where EDR devices are fitted. The US Regulation 49 CFR Part 563 – effective from September 2012 – remains an important reference point as it specifically requires manufacturers to provide EDR specification information to commercial providers of crash data retrieval systems. Recent consideration of extending the US Regulation to include 20 seconds of pre-crash data is notable. Other EDR regulations noted were those from Korea, Japan and China, while the SAE provide standard-based approaches to EDR equipment and data.

The original intent of EDR data was to provide manufacturers with information to evaluate the performance of vehicle safety systems and vehicle safety generally, as well as facilitating passive and active safety systems dynamically. The value of EDR data for research was quickly recognised, and provisions enabling EDR data to be used for research purposes were made within the US Regulation. A range of secondary use cases for EDR data have emerged (see Chapter 4). Primary considerations regarding use of EDR data relate to privacy. In the United States laws have been implemented to ensure that it is understood that the EDR data belongs to the vehicle owner and consent for its access is required; the consent of the driver to which the EDR data relates is also required in some US jurisdictions. Within the EU both access and the use of EDR data is constrained by the provisions of the GDPR that acts to protect the data that belongs to the vehicle owner.

Crash Data Retrieval (CDR) systems were also described, as were their costs to purchase. This set the basis to enumerate the proportion of vehicle models in Australia that are fitted with an EDR where data can be downloaded. The proportion of vehicle models fitted with a readable EDR was low, as evidenced by:

- Of the vehicles manufactured since 2000 and involved in a crash, approximately 30% of vehicles had an EDR that could be downloaded and read by currently available commercial systems in Australia.
- 57.3% of new vehicles sold in Australia in 2024 had an EDR that could be downloaded and read by currently available commercial systems in Australia.

The impact of the low support coverage for vehicles sold in the Australian market is significant. While the option exists to have individual EDR devices sent to a manufacturer to obtain a data report, to do so is cost-prohibitive for research and to a lesser extent police services. The lack of access to objective crash data available from EDR technology represents a significant missed opportunity to understand factors that contribute to crash occurrence and injury severity, and limits advances in road safety knowledge, policy and practice.

The findings reported here highlight the complexity of the regulatory environment surrounding EDR technology implementation and access. It is asserted that regulations pertaining to the fitment of EDR data systems are important to ensure standardisation of data collected and stored. Equally important for Australia is the need to ensure EDR data can be downloaded in an interpretable form for all vehicles. Regulations that require both fitment of EDR (and HVEDR) technology and access to stored EDR data are important to ensure that the maximum value promised by EDR data is realised. The next chapter highlights how EDR data can be used and in doing so sets out a benefits framework upon which a regulatory impact assessment can be undertaken.

4 USES OF EDR DATA AND ESTABLISHMENT OF A BENEFITS FRAMEWORK

This *Chapter* aims to identify the current uses of EDR data and the benefits of doing so. The *Chapter* is structured into five sub-sections, as well as a concluding comment section. The content of this *Chapter* represents the basis of a benefits framework that can be used in the assessment of an EDR mandate.

4.1 EDR DATA AS AN ENABLER OF ACADEMIC RESEARCH

In describing the use of EDR data in research it is not possible, nor necessary to provide a census of all research that has used EDR data. Rather, a thematic approach is taken here in order to highlight the various use-cases of the data. While the findings of the conducted research are of value, their influence on policy in particular is less well understood. Where benefits have been achieved through policy implementation or improved vehicle design, the degree to which benefit can be ascribed to the use of EDR data is difficult to ascertain. While it may not be possible to directly quantify the financial benefits of the use of EDR data in achieving these outcomes directly, it nonetheless remains important to describe such benefits at least in a qualitative manner.

The use of EDR data in research is a relatively recent phenomenon. The bulk of research conducted using EDR data has been done in the United States, with researchers at Virgina Tech being most prominent.[61] This stems from the availability of EDR in the United States[62] and long-established relationship of Professor Clay Gabler (d. 2021) with NHTSA. The Virginia Tech 'Gabler' research group conducted significant and voluminous research using EDR data into driver behaviour at intersections,[63] the study of injury risk in real-world crashes,[64] effects of active safety systems in crashes[65] [66] [67], airbag performance,[68] and the accuracy of EDR data including the correlation between delta-V and impact speed measured by EDRs.[69] [70] [71]

Other international researchers, including those in the UK, Sweden, and Germany, have used EDR data to explore topics ranging from understanding pre-crash vehicle movements and how active safety testing

[61] In particular, the work of Professor H. Clay Gabler (d.2021) has been most influential. See: Gabler H.C., Hinch J.A., Steiner J. (2008). Event Data Recorders, A Decade of Innovation. SAE. Note: Professor Gabler had a long association with MUARC and was involved in the ECIS program where EDR data was used.

[62] EDR data is freely available for crashes investigated in the NHTSA-funded National Automotive Sampling System (NASS) in-depth crash investigation Crashworthiness Data System (CDS) / Crash Investigation Sampling System (https://www.nhtsa.gov/file-downloads?p=nhtsa/downloads/NASS/EDR_Reports/). EDR (CDR) data is available for crashes since 2000.

[63] Scanlon, J. M., Kusano, K. D., & Gabler, H. C. (2015). Analysis of Driver Evasive Manoeuvring Prior to Intersection Crashes Using Event Data Recorders. Traffic Injury Prevention, 16 Suppl 2, S182–S189. https://doi.org/10.1080/15389588.2015.1066500.

[64] Gabauer, Doug and Gabler, Hampton C. (2008). Comparison of Roadside Crash Injury Metrics using Event Data Recorders. Accident Analysis and Prevention, 548-558.

[65] Scanlon, J. M., Sherony, R., & Gabler, H. C. (2017). Injury mitigation estimates for an intersection driver assistance system in straight crossing path crashes in the United States. Traffic Injury Prevention, 18 Suppl 1, S9–S17. https://doi.org/10.1080/15389588.2017.1300257.

[66] Kusano, K. D., & Gabler, H. C. (2012). Safety benefits of forward collision warning, brake assist, and autonomous braking systems in rear-end collisions. IEEE Transactions on Intelligent Transportation Systems, 13(4), 1546–1555. https://doi.org/10.1109/TITS.2012.219154

[67] Scanlon, J. M., Page, K., Sherony, R., & Gabler, H. C. (2016). Using Event Data Recorders from Real-World Crashes to Investigate the Earliest Detection Opportunity for an Intersection Advanced Driver Assistance System. https://doi.org/10.4271/2016-01-1457.

[68] Gabler, C., Thor, C., and Hinch, J. (2008). Preliminary Evaluation of Advanced Air Bag Field Performance Using Event Data Recorders," National Highway Traffic Safety Administration, Report No. DOT HS 811 015, USA.

[69] Niehoff, P., Gabler H., Brophy J., Chidester C., Hinch J., Ragland C. (2005). Evaluation of Event Data Recorders in Full Systems Crash Tests. National Highway Traffic Safety Administration, Paper Number 05-0271, USA.

[70] German, A., Comeau J.L., McClafferty KJ., Shkrum, M.J., Tiessen, PF. (2007) Event Data Recorders in the Analysis of Frontal Impacts. Annual Proceedings of the Association for the Advancement of Automotive Medicine, 51: 225-243.

[71] Gabauer, D.J., Gabler H.C. (2006). Comparison of Delta-V and Occupant Impact Velocity Crash Severity Metrics Using Event Data Recorders. Annual Proceedings of the Association for the Advancement of Automotive Medicine, 50: 57-71.

protocols can be developed and refined,[72] through to the conduct of 'what-if' simulations to understand safety benefits of forward collision warning (FCW) and autonomous emergency braking systems (AEB).[73]

Other recent uses include the estimation of motorcycle delta-V in motorcycle-to-vehicle impacts.[74]

Within Australia the Monash University Accident Research Centre (MUARC) and the Centre for Automotive Safety Research (CASR) at the University of Adelaide use EDR data in their research.

The EDR program at CASR has produced a significant number of works across a range of topics, as noted below. The CASR team have retrieved EDR data from crash-involved vehicles as part of its in-depth investigation studies and from crash vehicles stored at crash salvage yards. CASR researchers have also used EDR data collected by Victoria Police, with this data linked to injury severity data compensation data.[75] A major focus of the CASR research has been the formulation of injury risk curves by impact speed and impact direction.

Researchers at the MUARC used EDR data in the *Enhanced Crash Investigation Study (ECIS)* (see Section 3.4, this Report for detail). The MUARC ECIS team obtained the EDR data from crash-involved vehicles with the consent of both the vehicle driver and vehicle owner, if different. The EDR data was used to validate the crash reconstruction process used in the estimation of vehicle speed for all crashes. This paved the way for robust travel speed and impact speed data to be used in the study. It can be stated with certainty that having the EDR data saved 4 to 6 days of person-time per crash examined, translating to a financial saving of between AUD$ 3,863 to AUD$ 5,794 (2024 salary rates).

EDR data has been used by researchers at MUARC and CASR to establish or examine:

- Injury probability curves by impact direction and impact speed.[76]
- Ensuring the appropriate activation, and benefits, of automatic crash notification systems (ACN, or eCall).[77]
- Establishing the proportion of crashes where exceeding the speed limit was a contributing factor, which in turn is used to establish the business case for speed enforcement programs and Intelligent Speed Assist (ISA).[78] [79]
- Establishing the proportion of crashes where seat belts were not used.[80]
- Validating crash reconstruction methods, to then assess the likely impact of lower speed limits on crash and injury outcomes.[81] This also include a case-series approach of hypothetical 'what if' crash scenarios.[82]

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72 Thomson R., Sandin J., Bagdadi O., Hjort M., Augusto B., Andersson, H. (2013). EDR Pre-Crash Data: Potential for Applications in Active Safety Testing. Proceedings of the 23rd International Technical Conference on the Enhanced Safety of Vehicles, May 2013, Seoul.

73 Rao R.M. (2017). Using Event Data Recorder (EDR) data to perform What-if simulations for safety benefit analysis by reconstructing real traffic kinematics and driver behaviours. Thesis. Chalmers University of Technology, Gothenburg, Sweden.

74 Fatzinger, E. and Landerville, J. (2020). Using Vehicle EDR Data to Calculate Motorcycle Delta-V in Motorcycle-Vehicle Lateral Front End Impacts. SAE Technical Paper 2020-01-0885, 2020, https://doi.org/10.4271/2020-01-0885.

75 Doecke SD, Elsegood ME (2024). Event Data Recorders (EDRs) and high severity crashes: a summary of data collected by Victoria Police (CASR 237). Adelaide: Centre for Automotive Safety Research. https://casr.adelaide.edu.au/casrpubfile/3248/CASR237.pdf

76 Doecke, S. D., Baldock, M. R. J., Kloeden, C. N., & Dutschke, J. K. (2020). Impact speed and the risk of serious injury in vehicle crashes. Accident Analysis & Prevention, 144, 105629. https://doi.org/https://doi.org/10.1016/j.aap.2020.105629.

77 Nishimoto T, Kubota K, Ponte G (2024). A vehicle occupant injury prediction algorithm based on road crash and emergency medical data. Journal of Safety Research, 91, 410-422, doi.org/10.1016/j.jsr.2024.09.015.

78 Elsegood ME, Doecke SD (2024). Speeding prevalence and profile in high severity crashes: data from Event Data Recorders (EDRs) obtained by Victoria Police (CASR 238). Adelaide: Centre for Automotive Safety Research.

79 Doecke, S., Raftery, S., Elsegood, M., & Mackenzie, J. (2021) Intelligent Speed Adaptation (ISA): benefit analysis using EDR data from real world crashes, University of Adelaide Centre of Automotive Safety Research, CASR Report 176.

80 Doecke SD, Elsegood ME (2024). Event Data Recorders (EDRs) and high severity crashes: a summary of data collected by Victoria Police (CASR 237). Adelaide: Centre for Automotive Safety Research.

81 Peiris, S., Corben, B., Nieuwesteeg, M., Gabler, H. C., Morris, A., Bowman, D., Lenné, M. G., & Fitzharris, M. (2018). Evaluation of alternative intersection treatments at rural crossroads using simulation software. Traffic Injury Prevention, 19 Suppl 2, S1–S7. https://doi.org/10.1080/15389588.2018.1528357

82 Fitzharris, M., Corben, B., Lenné, M., Peiris, A., Pok Arundell, T., Gabler, H., Liu, S., Stephens, A. N., Bowman, D., Morris, A., & Tingvall, C. (2022). Speed, crash risk and injury severity, ECIS Report 2 (MUARC Report 344). Monash University. https://doi.org/10.26180/23305376

- Establishing the relationship between travel speed and crash risk, per case-control studies.[83]
- Establishing crash circumstances and the attribution of contributing factors in no-fault in-depth crash investigation (passenger vehicle, truck) studies.[84] [85] [86]

Other potential uses of EDR data, given sufficient volume of data includes:

- Using EDR derived delta-V and impact speed to statistically control for crash severity when seeking to identify the factors associated with injury severity, the findings of which can be used to inform vehicle countermeasure development when designing new vehicles and regulations.[87]
- Using EDR derived delta-V and impact speed as metric to statistically control, or adjust, for differences in crash severity when i.) assessing the real-world safety performance of vehicles and ii.) when evaluating the benefits of vehicle regulations, including for instance Australian Design Rules.[88]

4.2 EDR DATA AS A MECHANISM FOR THE DESIGN AND ASSESSMENT OF PASSIVE AND ACTIVE SAFETY PERFORMANCE IN VEHICLES

A primary rationale for the implementation of EDR technology and the use of the data contained therein relates to the use by manufacturers to improve the safety performance of their vehicles. This includes the optimisation of airbag performance,[89] [90] restraint (seat belt) systems, and the general crashworthiness of the vehicle.[91]

A further area of research for manufacturers has been the validation of the EDR collected data.[92] [93] [94] [95] This is seen to be important for the development Automatic Crash Notification Systems.[96]

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[83] Fitzharris, M., Corben, B., Lenné, M., Peiris, A., Pok Arundell, T., Gabler, H., Liu, S., Stephens, A. N., Bowman, D., Morris, A., & Tingvall, C. (2022). Speed, crash risk and injury severity, ECIS Report 2 (MUARC Report 344). Monash University. https://doi.org/10.26180/23305376

[84] Elsegood ME, Doecke SD, Ponte G (2023). Intersections and injuries: Insights from EDRs. 2023 Australasian Road Safety Conference, Cairns, Australia, 19-21 September.

[85] Peiris, S., Pok Arundell, T., Hampton, G., Curry, R., & Fitzharris, M., The MUARC-TAC Enhanced Crash Investigation Study: Using Event Data Recorders and Simulated Crash Reconstructions in the Analysis of Crash Causation, Monash University Accident Research Centre (MUARC), Proceedings of the 2015 Australasian Road Safety Conference, 14-16 October, Gold Coast, Australia.

[86] Fitzharris, M., Lenné, M., Corben, B., Pok Arundell, T., Peiris, A., Liu, S., Stephens, A. N., Fitzgerald, M., Judson, R., Bowman, D., Gabler, H., Morris, A., & Tingvall, C. (2020). Overview and analysis of serious injury crashes – crash types, injury outcomes and contributing factors, ECIS Report 1 (MUARC Report 343). Monash University. https://doi.org/10.26180/23305325

[87] Fitzharris, M., & Stephan, K. (2013). Assessment of the need for, and the likely benefits of, enhanced side impact protection in the form of a Pole Side Impact Global Technical Regulation. Monash University. https://doi.org/10.26180/23632488

[88] Fitzharris, M., Fildes, B., Logan, D., Newstead, S. (2006). Crash-based Evaluation of Australian Design Rule 69 (Full Frontal Impact Occupant Protection). Canberra: ATSB. https://www.infrastructure.gov.au/department/media/publications/crash-based-evaluation-australian-design-rule-69-full-frontal-impact-occupant-protection

[89] Wood, M., Earnhart, N., and Kennett, K. (2014). Airbag Deployment Thresholds from Analysis of the NASS EDR Database. SAE International Journal of Passenger Cars—Electronic and Electrical Systems; 7(1):230-245. https://doi.org/10.4271/2014-01-0496.

[90] Komari, O., Javidi, M., Merrill, Z., Toosi, K. (2019). Side Airbags Deployment Range from Analysis of Event Data Recorder Database of Real-World Incidents. SAE International Journal of Passenger Cars—Electronic and Electrical Systems; 12(2):163-171. https://doi.org/10.4271/07-12-02-0012.

[91] Armstrong, C.D. (2018).(Editor). Collision Reconstruction Methodologies Volume 7B: Event Data Recorder (EDR) Interpretation. SAE International. Also, Collision Reconstruction Methodologies Volume 7A: Event Data Recorder (EDR) Interpretation.

[92] Tsoi, A., Hinch, J., Ruth, R., and Gabler, H. (2013). Validation of Event Data Recorders in High Severity Full-Frontal Crash Tests. SAE International Journal of Transportation Safety 1(1):76-99. https://doi.org/10.4271/2013-01-1265.

[93] Tsoi, A., Johnson, N., and Gabler, H. Validation of Event Data Recorders in Side-Impact Crash Tests. (2014). SAE Int. J. Trans. Safety 2(1):130-164. https://doi.org/10.4271/2014-01-0503.

[94] Ruth, R. and Tsoi, A. (2014). Accuracy of Translations Obtained by 2013 GIT Tool on 2010-2012 Kia and Hyundai EDR Speed and Delta V Data in NCAP Tests. SAE Technical Paper 2014-01-0502. https://doi.org/10.4271/2014-01-0502.

[95] Bortles, W., Biever, W., Carter, N., and Smith, C., A Compendium of Passenger Vehicle Event Data Recorder Literature and Analysis of Validation Studies. SAE Technical Paper 2016-01-1497, 2016, https://doi.org/10.4271/2016-01-1497.

[96] Gabler HC, Hinch J. (2008). Evaluation of advanced air bag deployment algorithm performance using event data recorders. Annals of Advances in Automotive Medicine; 52:175-184.

4.3 EDR AS AN ENABLING TECHNOLOGY: INFORMING THE PROVISION OF EMERGENCY MEDICAL CARE THROUGH AUTOMATIC CRASH NOTIFICATION

4.3.1 eCALL AND EDR technology

eCALL, or Accident Emergency Call System (AECS), is a vehicle technology function that provides a mechanism for emergency contact to be made when assistance is required in the event of a crash. eCALL systems are also referred to as Automatic Collision Notification (ACN) systems. ACN systems that provide additional information concerning the estimated injury severity of vehicle occupants are referred to as Advanced Automatic Collision Notification systems (AACN).

eCALL has been mandatory in Europe in passenger cars and light commercial vehicles (Category M1 and N1) since 31 March 2018 under Regulation (EU) 2015/758.[97] There are a number of other regulations governing the implementation of eCALL within the EU. In short, eCALL systems must make direct contact with the European emergency contact number *112 (i.e., 000 equivalent),* in what is referred to as a Public Safety Answering Point (PASP)[98] following either a manual triggering of the 'S.O.S' function or via automatic triggering following an airbag deployment or other when another trigger event has occurred, such as a sudden deceleration (i.e., Automatic Collision Notification). Following notification of the crash, the emergency call centre may dispatch Emergency Medical Services (EMS, i.e., ambulance), Police, or the Fire Brigade as needed. EU systems must use global positioning provided by the Galileo and the EGNOS systems.[99] The call and any data transfer is enabled by an in-built *SIM card* installed in vehicles, in addition to other components.

The EU Regulations stipulate that eCALL systems must send a *Minimum Set of Data (i.e., MSD)* as a data packet including the time of the crash, the activation type (manual, automatic), location in the form of GPS co-ordinates (latitude, longitude), vehicle direction of travel, seatbelt use, Vehicle Identification Number (VIN), and fuel type (petrol/gasoline, diesel, CNG, LPG, electric, hydrogen). Systems may also include the number of occupants and other vehicle-related data. Voice transmission and hands-free interaction between the PASP centre and vehicle occupant(s) is also required. Updated requirements include the dynamic storage of a maximum of three last known locations with multiple location points sent to the PASP centre; this change comes into effect from 2026.[100] [101]

Included in the Regulation are requirements concerning privacy, data protection (i.e., storage, no tracking permitted), device technical requirements, and test procedures.

We also note here UN Regulation No. 144: Accident Emergency Call Systems (AECS).[102] UN R 144 provides uniform requirements for eCALL. Under UN R 144, the eCALL system must function with supporting at least three GNSS including GLONASS (Russian Federation), Galileo (EU) and GPS (USA) to ensure complete spatial coverage.

The UN Regulation No 144 makes explicit reference to the current frontal impact and side impact UN Regulations. Specifically, UN R 144 stipulates that the eCALL system is to be automatically triggered after an impact in accordance with UN Regulation No 94 (Annex 3, frontal impact [ADR 73]), as well as UN Regulation No 95 (Annex 4, side impact [ADR 72]). The manufacturer can also elect to automatically trigger eCall based on crash configurations different to, and/or of a lower severity than impacts specified in UN R 94 (frontal impact) and UN R 95 (side impact), however they must provide evidence that the required system performance is achieved whilst ensuring *unjustified* calls are not being made; this is to prevent over-triage of low severity or non-injury crash events. To ensure survivability of the system, the crash resistance (i.e., integrity) of the eCALL system is tested using a high deceleration sled test.

[97] Decisions, Directives and Regulations pre-date EU 2015/758, including Decision No 585/2014/EU (deployment of the interoperable EU-wide eCall service) and EU No 305/2013 (PASP requirements), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=PI_COM:C(2024)655&qid=1731738737098. For summary of provisions see: https://www.mobilityits.eu/esafety-ecall.

[98] EN 16072:2022 Intelligent transport systems – eSafety – Pan-European eCall operating requirements.

[99] See Global and China Automotive Emergency Call (eCall) System Market Report, 2022, for outline of eCALL in China and comparison across different markets. http://www.researchinchina.com/Htmls/Report/2022/71771.html

[100] Commission Delegated Regulation (EU) 2024/1084 amending Delegated Regulation (EU) No 305/2013. Official Journal of the European Union. 2024/1084, 12.4.2024. And: 2024/1180, 19.4.2024 - Commission Delegated Regulation (EU) 2024/1180 of 14 February 2024 amending Regulation (EU) 2015/758.

[101] EN 15722: 2020 Intelligent transport systems – eSafety – eCall minimum set of data (MSD). BSI Standard Publication

[102] Uniform provisions concerning the Accident Emergency Call Systems (AECS) https://unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2018/R144e.pdf

At present, eCALL is not mandated in Australia. However, as of 2025 the Australian New Car Assessment Program (ANCAP) requires eCALL to be fitted to vehicles to achieve a 5-star ANCAP safety rating.[103]

eCALL / ACN systems (manual, automatic) are fitted to some Australian vehicles, however these use Third Party Services (TPS) who then contact the '000' Emergency Call number. Examples include Audi Connect and Hyundai *Bluelink.*[104] Here it is worth noting that TPS are permitted in the EU Regulations, however the eCALL system must revert to the uniform EU 112 Emergency Number in the event that the TPS fails to function.

4.3.2 RELEVANCE OF ECALL TO THE ACU EDR DATA

The relationship of eCALL to vehicle data collected and stored in the EDR is complex but can be summarised as follows:

1. The collision detection system is comprised of sensors fitted in the Airbag Control Module/Unit (ACM / ACU)[105] and throughout the vehicle. Sensors include acceleration/deceleration sensors for the detection of frontal, side and rear impact crashes, rollover event sensors, and ESC sensors (inertial yaw and acceleration). Other sensors included pressure sensors for side impact crashes that are located in the door cavity, and pressure tube sensors for pedestrian impact detection that are located in the front spoiler of the vehicle. Sensors routinely collect data and then:
    a. Algorithms within the ACU using information dynamically stored on the EDR memory data card combine all relevant collected information to determine whether an 'above threshold' event (i.e., crash, hard deceleration) has occurred. Once and 'above threshold' event has occurred, pre-crash and crash-relevant data is locked and stored on the EDR.
    b. Inputs are used to calculate kinetic energy absorption in a crash.[106]
    c. Using data from other sensors received by the ACU, including occupant weight, seat belt sensors, vehicle speed, among others, injury severity can be estimated for use by advanced eCALL systems.
2. Upon detection of an 'above threshold' event, the ACU sends signals to relevant supplementary restraint systems (SRS) throughout the vehicle including non-reversible airbag systems and seatbelt pretensioners to deploy as needed. At the same time signals are also sent to other safety systems (e.g., hazard lights, fire suppression, turn off fuel pumps) where enabled.
3. eCALL is automatically triggered once the ignition signal is received from the ACU/EDR. The eCALL system is activated and relevant data is sent to the emergency call number.

The data collected and processed by the ACU – and first dynamically and then statically stored in the EDR — plays a critical role in eCALL systems by determining whether a crash of sufficient severity has occurred that requires an emergency response.[107] [108] [109] As noted above, Advanced Automatic Crash Notification (AACN) (eCall) systems can use relevant data inputs to advise emergency services of the probability of serious injury to vehicle occupants, further aiding in early decision-making by emergency services. This last point relates to a research use of EDR data, where the development of injury risk probabilities using real-world injury outcome data can refine algorithms used to trigger eCALL/AACN services.

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[103] Announced in 2021. These include specific requirements relating to eCALL and the infrastructure required for its operation.

[104] Of note, some manufacturers and vehicle models are negatively impacted by the 3G band closedown. Bluelink (Hyundai) uses Optus (Singtel) services; a software update is required for impacted models.

[105] Also referred to as Airbag Control Unit (ACU), Airbag Sensor (e.g., Toyota), or Sensing and Diagnostic Module (SDM Airbag Module / SRS, Holden); examples: Bosch - https://www.bosch-mobility.com/en/solutions/control-units/airbag-control-unit/

[106] Occupant safety Airbag control unit, generation 12. https://www.bosch-mobility.com/media/global/solutions/passenger-cars-and-light-commercial-vehicles/driving-safety-systems/pedestrian-protection/integrated-safety-unit/product_data_sheet_integrated_safety_unit.pdf

[107] The CCU is one component of the Accident Emergency Call Device (AECD) which when fitted is referred to as the AECS. The terms AECC/AECD/AECS are used in this joint format through UN R 144.

Commission Delegated Regulation (EU) 2017/79, Technical requirements and test procedures for the EC type-approval of motor vehicles with respect to their 112-based eCall in-vehicles systems. ANNEX V Automatic triggering mechanism. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32017R0079

[109] EDR - QAs – 2006. NHTSA. https://www.nhtsa.gov/document/edr-qas-2006

It is clear then that data processed within the ACU, of which the EDR is an integral part, is enables eCALL. Hence, benefits attributed to the automatic triggering of eCall[110] [111] can in part be allocated to EDR fitment. This applies in implementation scenarios where the configuration of the eCALL system is such that the activation tigger (i.e., airbag ignition or other signal) is sent to it by the ACU/EDR system. To the authors knowledge, the dependence of eCALL on the ACU/EDR event trigger signal is seen in most, if not all, passenger vehicle eCALL systems. The implementation of eCALL systems may differ in heavy vehicles where airbags are not fitted.

It remains important to clarify that the fitment of an Airbag Control Unit and included EDR is independent of, and pre-dates, the fitment of eCALL systems.

4.3.3 ESTIMATED COSTS AND BENEFITS OF ECALL

The estimated benefits of eCALL for Australia were examined by MUARC in 2008.[112] This analysis estimated that the improved response time facilitated by immediate crash notification would save an estimated 104 fatalities on Australian roads per annum (41 urban and 63 rural), assuming all vehicles were fitted with an Automatic Crash Notification (ACN) system. This corresponded to close to 11% of all passenger vehicle occupant fatalities at that time.

In a study published in 2013, the Centre for Automotive Safety Research (CASR) at the University of Adelaide estimated that the effectiveness of ACN in reducing fatalities to be between 2.2% - 4.4% per year, with this being a conservative estimate according to the authors.[113]

More recently, the MUARC *Enhanced Crash Investigation Study (ECIS)* demonstrated that eCALL would have been of direct and significant benefit to 5.5% of serious injury crashes where crash notification was delayed and/or there was difficulty locating the vehicle due to problems of access in remote locations.[114]

These benefits are likely to be significant in financial terms. The full cost of implementing eCALL (AACN) into Australia remains to be determined.

4.4 ROLE OF EDR DATA IN POLICE FORENSIC INVESTIGATIONS

4.4.1 Role of Police in crash investigations

Police have a central role in the investigation and reporting of crashes. The assessment of crashes with respect to causation and the responsibility for determining whether any offences were committed that led to the crash rests solely with the police. Police are responsible for putting together a *Brief of Evidence* in the event a driver (or road user) is charged with an offence.

Depending on the severity of the crash, *General Duties Police* may work with *Highway Patrol* police in manging the crash scene, investigating the crash, and finalising offence charges where relevant. For a subset of crashes, police *Major Collision Groups* investigate crashes. The criteria for investigation of crashes, using Victoria Police as an example, are: crashes where three of more people are killed; crashes where there is a life-threatening injury or fatality where there is evidence to suggest criminal activity (e.g., hit run, negligence by surviving driver); crashes that involve a Victoria Police member (on/off duty), and crashes that occur in the course of a pursuit. In these crashes, *police forensic services* are engaged.

Consultation with police for the purpose of this *Report* highlighted the high value that is placed on EDR data. Used as a direct input to the reconstruction of crashes, EDR data is stated to provide an objective basis for understanding crash events and represents a significant value-added input to the investigations process, the

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[110] Once off patent licensee (vehicle manufacturer) costs for accessing mobile connectivity for eCALL (and associated services) is $20/vehicle (4G) and $32 / vehicle for 5G connectivity. https://www.avanci.com/vehicle/4gvehicle/ https://www.avanci.com/vehicle/5gvehicle/

[111] Note: Once off patent licensee (vehicle manufacturer) costs for accessing mobile connectivity for eCALL (and associated services) is $20/vehicle (4G) and $32 / vehicle for 5G connectivity. https://www.avanci.com/vehicle/4gvehicle/ https://www.avanci.com/vehicle/5gvehicle/

[112] Lahausse, J. A., Fildes, B. N., Page, Y., & Fitzharris, M. P. (2008). The potential for automatic crash notification systems to reduce road fatalities. Annals of advances in automotive medicine. Association for the Advancement of Automotive Medicine. Annual Scientific Conference, 52, 85–92.

[113] Ponte, G, Ryan GA., Anderson, RWG. Automatic Crash Notification. Centre for Automotive Safety Research (CASR). The University of Adelaide.

[114] Fitzharris, M., Pok Arundell, T., Corben, B., Lenné, M., Liu, S., Peiris, A., Stephens, A. N., Bowman, D., Morris, A., & Tingvall, C. (2022). Identification of countermeasures to address serious injury crashes, ECIS Report 4 (MUARC Report 346). Monash University. https://doi.org/10.26180/23305388

value of which cannot be overstated. EDR data is widely accepted by the Courts, noting however there are checks and balances in its use within the broader *Brief of Evidence* (see below). It was stated that access to EDR data represents a significant leap forward in the conduct of investigations by providing concrete and objective data not previously known.

4.4.2 Access rights to EDR data

On the subject of access rights, Police have significant legislative and common law powers when investigating crashes. This includes the seizure of vehicles where it is believed that an offence or crime has been committed. In the scenario where a vehicle is on private property, the police obtain a search warrant and seize the vehicle. When seized under these circumstances, police have all necessary powers to access the EDR, and the data contained therein.

4.4.3 Use of EDR data in practice and its role in forensic investigations

Police forensic investigation teams undertake a comprehensive workup of the crash scene as part of their investigation. This includes the use of 3D laser scanners (e.g., Trimble X7 3D Laser Scanner[115]) to capture the environment and scanners to measure distance data (e.g., skid marks) with precision (e.g., Trimble® SX12 scanning total station).[116] Crashes are reconstructed using dedicated programs (e.g., Virtual Crash 5.0; PC-Crash). Combined with the evidence obtained from involved driver(s), witness statements, any video/CCTV evidence, mobile phone records, and inspection of the involved vehicle(s), police then make assessments of the crash circumstances.

EDR data, even if available for only one crash-involved vehicle, provides significant value to investigations by providing an objective record of vehicle movement and pre-crash driver actions, including braking and steering (i.e., avoidance actions), vehicle speed at impact (and the immediate period beforehand), and seatbelt use. This data gives objective insight into behaviour pre-crash. For instance, using the available data in conjunction with detailed scene maps obtained using scanning equipment (see above), it is possible to re-create the vehicle trajectory in time and space (e.g., in metres) prior to the impact, using the impact point (t=0) as the reference and working backwards. Using this, reference can be made to traffic control signals, intersection points, and lane markings. The availability of steering inputs, yaw marks and brake position, for instance, add significant value to the reconstruction. For single vehicle fatality and serious injury crashes, EDR data represents a key point of evidence, while EDR data is highly informative for collisions involving multiple impacts. Having access to other vehicle data systems, such as video and related sensor data (e.g., Subaru SmartEye), would further improve the investigation process.

The EDR data can also be used to document the application of throttle (i.e., use of accelerator pedal) and the type of braking, if any, pre-crash (e.g., hard braking vs last minute braking vs. no braking at all). This data can be used to infer intention (including driver inattention) and validate driver and witness statements concerning driver pre-crash behaviour. Immediate access to the EDR data following a crash is highly advantageous by providing an investigating officer with objective data to progress a standard crash report to finalisation in a timely manner.

Another validation data point that police use is the delta-V, or change in velocity, in combination with other EDR data points. Combined, these data can be indicative of the type and severity of injuries expected. This data also underpins Advanced Automatic Crash Notification (AACN) eCALL systems, as discussed above.

In the absence of EDR data, the time to complete the crash investigation is extended. Reliance on collected evidence – not including EDR data, may result in a lack of information or information being less precise. For the purpose of prosecution, this data requires verification and validation. Computer-based crash reconstructions are undertaken, with simulations being completed, including the use of Monte-Carlo methods as a means of reducing error in crash estimates. With the burden of proof (beyond reasonable doubt) resting with police, a conservative approach is taken. Where EDR data is not available, a lack of physical evidence can hinder investigations and make crash reconstructions more difficult to undertake. By way of example, vehicles fitted with ABS and AEB tend to leave lighter skid marks that degrade in a matter of hours, or none at all; this is due to differences in advanced braking systems preventing wheel lock. Hence, the estimation of speed and assessment of driver avoidance actions is compromised. This scenario alone points to the importance EDR data for Police.

4.4.4 Acceptance of EDR data by the Courts

[115] Trimble X7 3D Laser Scanner. https://fieldtech.trimble.com/resources/product-guides-brochures-datasheets/datasheet-trimble-x7-3d-laser-scanner

[116] Trimble SX12. https://geospatial.trimble.com/en/products/hardware/trimble-sx12

It was stated that in the experience of the police, EDR data is accepted by the Courts. There are, however, many checks and balances to ensure that the EDR data relates to the crash in question. This includes interpretation of the *ignition cycle data* variables in the EDR system and validation against material obtained through physical inspection of the scene and the vehicle at the time of the crash by attending police. This includes the use of detailed diagrams of the crash based on evidence collected at the scene, including photos of vehicle in-situ, and driver/witness statements.

A key consideration in police prosecutions is the need to prove at a standard *beyond reasonable doubt* that an offence was committed, or a driver engaged in criminal activity. By having objective EDR data as part of the investigation process, the prosecution case is strengthened.

With respect to relying on EDR data on its own to prove an offence in a crash, for example exceeding the speed limit, EDR data is used in this way; corroborating physical evidence, such as the extent of vehicle crush and other EDR metrics relevant to the crash, is also used in such cases.

That the EDR does not collect time, date and location does not present as a problem for Police. This is due to police attending the crash, the locking of data by the EDR system upon airbag deployment (and other EDR locking triggers), and checks and balances already noted.

4.4.5 EDR data accessibility

Notwithstanding broad powers in accessing vehicles, police encounter significant challenges in physically accessing interpretable EDR data given the limited coverage of vehicles in the Australian fleet by currently available commercial crash data retrieval systems.

In cases where a crash-involved vehicle has an EDR that is not supported by currently available commercial crash data retrieval systems, Police send the ACU/ECU (controller) that contains the EDR data to overseas-based manufacturers to obtain the EDR data report. This is time consuming and expensive, and cost-prohibitive for academic researchers. By way of example, sending a single ACU/EDR unit to Germany to be read comes at considerable cost, both in terms of time (8 – 12 weeks) and money (~€4,000, AUD $6,477). Due to the evidential value of the EDR data and the significance of the investigation (prosecution) outcome, police utilise this service from manufacturers when necessary.

It was stated that there is a pressing need to force manufacturers to provide access and interpretation specifications to allow EDR data to be read for all vehicles on Australian roads, similar to the US Regulation 49 CFR PART 563. Doing so would provide significant cost and time savings for police, as well as increasing the number of crashes where EDR can be used as part of the investigation process.

4.4.6 Estimating the time and financial benefits to Police having access to EDR data

Based on information provided by police forensic services, it was estimated that access to EDR data would save on average, 5 person days per investigated crash.

For the sake of estimation of cost savings and using a 5-day average saving (at 8 hours/day) per investigated crash by using EDR data, an average salary of $78.00 per hour is used (per the Victoria Police EBA), equating to $3123.61 for the five days.[117] Including statutory on-costs for superannuation, Workcover, and leave provisions (+1.41%), the cost saving to Victoria Police by having access to EDR data is estimated to $4,404.29 per crash. Due to the exclusion of shift and other allowances, this is the *minimum saving benefit* in crash reconstruction costs, including the writing of a Forensic Investigation Collision Report and inputs to the *Brief of Evidence*. At an average of 400 crashes investigated each year by Victoria Police, this represents a cost saving of $1,761,716 to Victoria Police (2023 salary values). This benefit is offset somewhat by the continued need to pay for costs associated with sending ACU/EDR devices overseas to be read. This does not include savings in Court time and other investigation costs that can be considerable. With the time savings achieved, police can also investigate additional crashes, pursue other police matters, or take leave and rest (i.e., opportunity cost).

[117] Victoria Police (Police Officers, Protective Services Officers, Police Reservists and Police Recruits) Enterprise Agreement 2019. The Police Association. 22 May 2020. Link Collision Reconstruction and Mechanical Investigation Unit (Clause 191.1), and Schedule A, and Clause 191, specifying Senior Collision Reconstruction Expert Level 4 (Schedule A – salary, Schedule B – Salary Related Allowances, as per Clause 45.2 (An employee not above the rank of Senior Sergeant employed as a Detective will receive COT 2 in accordance with Schedule B.) Range $145,208 - $146,961 (2023), plus Commuted Overtime Allowance (COT 2) of $16,790 for sum of $161,998 to $163,751 (excludes after hours work). At ordinary hours of 80 hours / fortnight, with 26.071 fortnights, total yearly working hours (EFT 1.0) is 2085.71. With an annual salary, including allowances (but excluding shift allowances after hours work (intrusive & unsociable hours), meal & other allowances, the per hour salary rate is $77.67 to $78.51.

These 400 crashes represent an important subset of fatal and serious injury crashes in Victoria, these being those that meet the criteria laid down by the Major Collision Investigation Unit[118] This number includes crashes where the Collision Reconstruction and Mechanical Investigation Unit of the Forensic Services Department are requested to investigate by Victoria Police Highway Patrol and/or General Duties Officers.

For reference, in 2023 there were 261 crashes involving at least fatality (total fatalities = 295) and 5075 crashes[119] where at least one road user was hospitalised (excluding fatality crashes) (total hospitalised TAC claimants = 5,473[120]). Hence, in 2023 in Victoria there were 5,336 fatality and serious injury (FSI) crashes. These 400 crashes equate to 7.3% of all FSI crashes. Any requirement that leads to easier and broader access to EDR data would be of significant benefit to Police, potentially permitting objective crash data to be obtained from a larger number of FSI crashes. A further benefit would be the more efficient and timely completion of Police Collision reports. This would bring additional benefits to efforts in prosecuting road users for wrong-doing and further enhance road safety efforts.

4.4.7 Key points

- Police have responsibility for the investigation of crashes and the determination of crash causation. This is done with a view to determining whether an offence was committed or there was evidence of criminal activity that resulted in the crash.
- EDR data plays a key facilitating role in the work of Police in investigating crashes. EDR data provides objective data and enables determination of causes of crashes to be made with objective certainty.
- Access to EDR data provides considerable time and cost savings to Police. The use of EDR by police is applicable to both light commercial vehicles and heavy vehicles.
- A national estimate of cost savings to Police nationally could be derived and used as an input for any future regulatory impact assessment.
- Greater ease of access, including across all vehicles sold in Australia, is important moving forward, as is the inclusion of data points relating to emerging active safety technologies.

4.5 ROLE OF EDR DATA IN THE INSURANCE SECTOR AND FORENSIC INVESTIGATIONS

4.5.1 The insurance landscape in Australia

The Motor Vehicle Insurance Industry and statutory compulsory third-party (CTP) insurers (i.e., injury compensation schemes), such as the Victorian Transport Accident Commission (TAC) and the NSW State Insurance Regulatory Authority (SIRA), play an important role in assisting road users involved in a crash.

It is not possible, nor necessary for the purpose of this *Report,* to provide the full detail of services provided by these insurers. Rather, a very high-level description of the insurance landscape as it applies to crashes is provided. This is done to contextualize the role of forensic investigations in the insurance industry, and the role that EDR data plays as part of such investigations.

4.5.2 Motor Vehicle Insurance

The motor vehicle insurance industry has a range of products and services that vehicle owners purchase in favour of repair and/or replacement of damaged vehicles in the event of a crash (e.g., Alliance Product Disclosure Statement, PDS). The Insurance Council of Australia provides an overview of insurance products and a full list of insurers and reinsurers.[121] Vehicle owners pay a premium for this insurance.

In purchasing insurance for their motor vehicle, the owner (or responsible party) has a number of obligations to the insurer. These obligations are covered by law, including through the *Insurance Contracts Act 1984*

[118] MCIU crash investigation criteria: : crashes resulting in 3 or more people being killed; where there is a life-threatening injury or fatality where there is evidence to suggest criminal activity (e.g., hit run, negligence by surviving driver); the crash involves a Victoria Police member (on/off duty); crashes that occur as a result of a pursuit involving Victoria Police. The Victoria Police MCIU responds to crashes 24 hours / 7 days a week across Victoria.

[119] Statistical aanalysis of Victoria road crash data, available at https://discover.data.vic.gov.au/dataset/victoria-road-crash-data

[120] Transport Accident Commission (TAC). Claims Involving Hospitalisation, Annual 2023, https://www.tac.vic.gov.au/road-safety/statistics/tac-hospitalisation-reports/claims-involving-hospitalisation-annual

[121] Insurance Council of Australia: https://insurancecouncil.com.au/industry-members/members-and-member-brands/

(Cth)[122] and the *Product Disclosure Statement (PDS)* of the motor vehicle insurance policy. For instance, under the *Act,* the insured party must take *reasonable care not to make a misrepresentation (s.20B)* when providing information and has *Duty of Disclosure* (s.21) to provide all relevant information at the time the policy is purchased, renewed, varied, extended, reinstated or replaced, including relating to any convictions for fines and penalties imposed for a serious criminal and/or driving offence among other offences.[123] The *Act* also has provisions to protect the insurer against fraudulent claims (s.56), including the provision of false information by the insured party. Insurance policies have a number of exclusions within the PDS, including, for instance, 'any legal liability caused by or arising from an intentional act by you or any other person'.

When an insured person makes a claim for damages and loss in respect of their vehicle, the insurer has the right to verify the circumstances of the crash and validate the claim. Per an exemplar PDS, the insurer must be able to prove they have suffered a loss, including by providing the insurer with *all information required to settle or defend the claim,* and to give all reasonable help and information…this may include attending court to give evidence. (p.26)[124] The insurer also states that they have 'full discretion in the conduct of any claim or issue legal proceedings… you must co-operate by giving us any statements, documents or assistance we require'. (p.26)[125]

Under these provisions, the insurer (and its agents) has the right to request and obtain police reports and to assess the vehicle inclusive of having access to EDR data in order to verify and validate the circumstances of the crash. It is understood that the EDR data, as part of the vehicle, remains the property of the driver while the vehicle control unit that holds the EDR data is the property of the vehicle owner; it is due to this that the insurer has the right to access EDR data in exercising their rights. Investigations play a role in ensuring the validity of the claim and to protect the insurer against fraudulent claims,[126] which includes staging crashes[127] (i.e., deliberately damaging the insured vehicle/property and making it appear it was unforeseeable) and purchasing a policy after a crash and then making a claim.[128] Being overinsured is an important risk flag for insurers.

In relation to claim outcomes, in their 2019 report, *Roadblocks and roundabouts: A review of car insurance claim investigations,* the Australian Securities and Investments Commission (ASIC), reported that of 1.6 million claims insurers flagged 4.85% of claims as suspicious with 17,587 investigated (1.1% of claims). Of these 17,587 investigated claims, 71% were paid (n = 12,486), 4% were declined for fraud (n = 703), and 10% were declined for 'other reasons' (n = 1,758), and 15% were withdrawn (n = 2,638).[129] While the proportion of these claims that relate directly to damage from crashes was not specified, these data highlight the importance of claim verification procedures.

When an insured person makes a claim against their policy for vehicle damage due to a crash, common practice is that the insured party is requested to provide:

- A description of the crash, including the location and time of the crash. This can include drawing the crash.
- Photos taken immediately after the crash.
- Description of damage to the vehicle.
- Details of police attendance and provision of relevant reports.

Vehicles are inspected by insurance damage assessors. Witness Statements are also obtained, as is the version of events from the other involved party where applicable.

Where questions arise as to the validity of a claim, insurers utilise the services of private investigation services. This may include interviewing the driver and taking photographs of the crash location (as reported). A report is then provided to the insurance company.

A second step may involve the insurance company commissioning a Forensic Engineer. As an agent of the insurance company the Forensic Investigator receives all relevant information relating to the claim and

122 Insurance Contracts Act 1984, No. 80, Compilation No. 32. Compilation date: 1 March 2024. https://www.legislation.gov.au/C2004A02944/latest/text
123 Allianz – Cover Direct Insurance. Product Disclosure Statement
124 QBE Product Disclosure Statement and Policy Document, for Motor Vehicle Insurance.
125 QBE Product Disclosure Statement and Policy Document, for Motor Vehicle Insurance.
126 Insurance Council of Australia. Insurance Fraud. https://insurancecouncil.com.au/consumers/insurance-fraud/
127 Lyons Law Group. Insurance fraud Australia. https://lyonslaw.com.au/insurance-fraud-australia-the-law/
128 Financial Rights Legal Centre. Insurance fraud is a criminal offence. https://financialrights.org.au/factsheet/insurance-investigations/
129 ASIC July 2019 | REP 621 Roadblocks and roundabouts: A review of car insurance claim investigations.

conducts a detailed investigation of the crash. This can include, but not always, the use of software to reconstruct the crash (e.g., FARO). In determining whether the crash occurred as described (including the crash location), whether the crash description is consistent with the road geometry, the surrounding environment, and damage to the vehicle needs to be determined. Parameters of interest are the direction of impact, whether braking occurred or other avoidance actions, the extent of crush, airbag deployment, and seat belt use.

Where possible, Forensic Investigators access EDR data due to its value as an objective record of vehicle movements and driver avoidance actions in the period immediately prior to the crash. Access to the 5-seconds of pre-crash data can place driver intentions before the crash occurs, including through the use of steering inputs to determine avoidance actions, acceleration and braking. The EDR data also validates impact speed and through the use of lateral and longitudinal delta-V measures the direction of impact. By aligning this with the impact object, further determinations of how a crash occurred can be made. As EDRs store multiple events, it is possible to also determine timing of impact events relative to each other, for instance, in situations where a rear impact occurs pushing a vehicle into another vehicle (i.e., frontal impact for middle vehicle). EDR parameters such as *ignition cycle* and *time between events* are used by the investigator when assessing the timing of the crash. EDR data is also useful in assessing claims that a vehicle was *hit-while-moving* but where no EDR event was recorded; this goes to the reported severity of the crash and reported vehicle damage. The lack of location and time/date data, while a limitation, does not on its own make the use of the EDR data any less valuable due to use of other information sources when investigating a crash.

Following advice from an experienced and highly qualified forensic engineer, the EDR data for a high proportion of investigated claims can be obtained directly from the vehicle ODB2 port rather than removing the ACU/ECU (control unit) from the vehicle. This is due to the generally lower crash severity of insurance claims relative to crashes investigated by the Police.

EDR data is obtained from vehicles where coverage is provided by the Bosch Crash Data Retrieval (CDR) system, noting that the Telsa EDR and Hyundai GIT system are now available and theoretically provide coverage to Australian Tesla and Hyundai group vehicles. As shown in Section 3.4, the Bosch CDR does not cover all vehicles in Australia with an EDR. That this is the case is due to a lack of a requirement for manufacturers to make the specifications to access, read, and interpret EDR data available to commercial providers. This is important to address in the future. As crash avoidance technologies continue to be added to vehicles, capturing whether these were active at the time of the crash will be another important step forward in any crash investigation process.

While forensic investigations are still undertaken in the absence of EDR data, the EDR data provides certainty of events and gives greater confidence to findings. A forensic report generally makes findings with respect to consistency of the claimant's version of events, reflects on any inconsistencies, and makes statements in relations where aspects of the crash cannot be determined or remain unknown. Access to the EDR enables these conclusions to be more precise. The objective nature of the data provides further certainty to the conclusions, making them more authoritative. The time saving by having access to EDR data and using it as an input to crash reconstruction is approximately 5-days, which in financial terms is estimated to be an average of $6,250 per investigation. This does not include savings to the insurer from litigation that is avoided and payout of otherwise fraudulent claims.

It is important to highlight that EDR data has been used in Court. In *Issa v Australian Alliance Insurance Company Ltd (t/as Shannons Insurance),* Supreme Court of New South Wales, 20 September 2016[2016] NSWSC 1320(2016) 78 MVR 12016 WL 4991339, the use of EDR data was affirmed. In short, the plaintiff sought to appeal the decision of a Magistrate with regard to a claim of fraud, brought by the insurer. Per (1)(g)(95) of the Appeal *Judgement,* **Harrison AsJ** stated that:

> ...in their joint report the experts agreed that the retrieval of crash data from the [~~vehicle model name~~] **EDR** showed impacts that were inconsistent with the claimed collision's circumstances and location.

And earlier

> 32.2 The data present in the CDR report from the [~~vehicle model name~~] EDR is compatible with the physical evidence...

Harrison AsJ refused the Leave to appeal by the Plaintiff and the appeal dismissed. Costs were awarded to the Insurer.[130]

[130] From Westlaw legal database, through https://anzlaw.thomsonreuters.com/ (available at Monash University).

The above NSW Supreme Court case highlights both the critical nature of EDR data for the insurance industry and points to its acceptance by the Court.

Key points:

- Providers of Motor Vehicle Insurance have a responsibility to validate claims made by insured drivers, while insured drivers have a responsibility to provide accurate information for this assessment to be made. Due to the terms of the *Product Disclosure Statement,* insurers are able to access the vehicle and all information it contains as part of its investigations, including the EDR data.
- For a subset of claims, insurers use investigation services to validate the circumstances of the crash.
- EDR data provides an objective record of the crash and can be used to understand the driver's behaviour and intentions in the time immediately before the crash. Access to EDR data saves time in the investigation but also provides greater certainty and confidence in assessing motor vehicle damage claims. This applies to crashes involving light passenger vehicles and heavy vehicles.
- Objective data relating to the engagement (active) status of Advanced Driver Assistance Systems (ADAS), obtained via the EDR, is immensely valuable to insurers and forensic investigators. EDR standards need to keep pace with these developments and additions to vehicles.
- There is a need to ensure that a) all vehicles are fitted with an EDR, and b) that manufacturers are obliged to provide the specifications for EDR data to be not only accessed but to be interpreted. Ensuring this common approach will ensure that EDR data can be used for the investigation of all crashes as required.

4.5.3 Third-party insurers: injury and statutory compensation schemes

In contrast to provision of insurance coverage for vehicle damage and loss, statutory compulsory third-party (CTP) insurers, such as the Victorian TAC and the NSW SIRA, provide coverage for 'medical and like' expenses associated with being injured in a crash, loss of earnings due to being unable to work, financial settlements (i.e., impairment lump sum) based on percent impairment inclusive of physical and mental health impairment (e.g., TAC, 11% or more),[131] [132] and common law benefits associated with high levels of impairment where an at-fault party (vehicle controller / road user) can be determined. Owners of registered vehicles pay an annual fee most often as a component of the annual vehicle registration fee. In some Australian States CTP insurance is referred to as 'green slips' (e.g., NSW).

In the event of being involved in a crash, road users must lodge a *Claim*. The claimant is obliged under law to provide accurate and all necessary information to that statutory authority for the claim to be assessed for the purposes of eligibility. Information is routinely obtained from the police, including forensic investigation reports where available. The Police report is vitally important, as it can detail whether the crash occurred on a public road, whether the driver / rider was unlicensed, and who owned the vehicle.

Eligibility to some benefits is reduced based on the circumstances of the crash. For instance, eligibility for loss of earnings payments and lump sum impairment benefits is curtailed where a road user is convicted of an alcohol and/or illicit drug-related vehicle offence, or is convicted of culpable driving under the *Crimes Act (1958)*; this being driving where the driver causes the death of another person by driving a motor vehicle recklessly, negligently or while under the influence of drugs or alcohol to the extent of being incapable of having proper control of the vehicle.

In addition to impairment lump sum benefits, a right to common law compensation exists from the statutory authority (e.g., TAC in Victoria[133]). Eligibility is dependent on i.) an individual being assessed as suffering from equal to or greater than 30% impairment (and this impairment level is stable over time), and ii.) demonstration of another party to be fully or partly at-fault (i.e., negligent) for the crash.[134] [135] Compensation is for loss of past and/or future earnings and pain and suffering. This compensation is paid by the statutory authority on behalf of the person demonstrated to be at-fault. It is up to the injured person to launch common law proceedings and most frequently this is done through a specialist personal injury lawyer. Key roles for the

[131] Transport Accident Commission. Impairment benefits. Information link.

[132] Transport Accident Commission. Impairment payments for accidents on or after 16 December 2004. Link on financial sums associated with percent (%) impairment. In accordance with the American Medical Association (AMA) Guide to the Evaluation of Permanent Impairment (Fourth Edition) (other than Chapter 15). Link

[133] Transport Accident Commission. Information for Clients. Link to claim information brochures

[134] Fitzharris, M., Liu, S., Shourie, S., & Collie, A. (2013). Factors Associated with Common Law Claims Lodged to The Transport Accident Commission. Monash University.

[135] Transport Accident Commission. Fault or negligence. Link

authority (in this case the TAC) is the issuance of a *Serious Injury Certificate,* certifying that the client meets the 30% impairment threshold, and the investigation of crash circumstances to ensure eligibility; this entails the establishment of an at-fault party. While statutory insurers access material relating to police investigations, these authorities commission other private and forensic investigation services when required, as do legal firms engaged by the claimant.

The above highlights the critical role of objective and robust information concerning crash circumstances, something that can be enhanced by access to EDR event data.

Finally, given the nature of the schemes robust mechanisms —including automated flags — exist for the detection and investigation of fraudulent claim activity, including overservicing and overcharging. Doing so is important to protect the scheme integrity.[136] [137] While this detection and investigation activity largely sits within the claim management domain, establishing the nature and severity of injuries sustained from that crash event is important to ensure consistency with the crash event as described.

Key points:

- CTP insurers must validate claims for eligibility in the first instance and once accepted assess eligibility for specific benefits. With access to benefits being reduced or disallowed based on road user behaviour and criminal convictions, the Police report and Evidence Briefs for Court action — inclusive of forensic reports — plays a vital role in assessing the claim. These reports, including Court outcomes (where applicable) are also used for establishing common law claim eligibility. These outcomes are available to CTP authorities at the time of eligibility assessments being performed. In this sense, CTP providers benefit from access to EDR data that occurs upstream.

- Statutory authorities utilize private forensic services to report on crash circumstances; these are similar services to that used by the motor vehicle insurance industry (see previous section). These reports are especially relevant in assessing claims where the police may not have attended the scene and/or undertaken a full forensic analysis of the crash. Having said this, addressing fraudulent claim activity by overstating injuries and/or overservicing are the dominant focus of private investigation groups in the CTP sector. Given the nature of impairment and common law claims, CTP insurers largely would rely on Police information and Court (prosecution) outcomes.

- CTP insurers benefit significantly by having access to prosecution and conviction information relating to those involved in crashes. As discussed above, the police benefit significantly by having access to EDR data. With CTP insurers being a downstream beneficiary of this process, it is arguably difficult to quantify with any precision the financial benefits to CTP insurers of having access to EDR data.

  On the above, it is worth noting that in the 2023-24 financial year there were 1,352 common law claims resolved with $425 million in entitlements paid.[138] This is significantly more than the number of crashes subject to a full forensic investigation by Victoria Police in any single year, however the common law claims process takes time largely due to impairment needing to be assessed as *stable.* (see above). Nonetheless, and given the eligibility to benefits is reduced where impaired driving is shown (alcohol/drugs), access to Police investigation and Court outcome data vital for CTP insurers.

  It is likely then that the time benefit of having access to EDR is accrued upstream to the Police rather than directly quantifiable benefit to CTP insurers given the requirement of serious injury, impairment assessments, and the nature of eligibility / exclusion criteria.

- Due to its objective nature and use by Police, EDR data will continue to play a vital role in ensuring benefits are paid where appropriate. Any step to improve the uniformity and ease of access to EDR data will likely improve the efficiency of the claims management process.

- Due to their role in society, it remains imperative that the integrity and viability of third-party schemes are protected. While direct financial benefits of access to uniform EDR data may not be immediately quantifiable, acknowledging the role that EDR data plays in CTP claims management processes is important when considering an EDR mandate.

4.6 CONCLUDING COMMENT

[136] Insurers and MAIC protect motorists by detecting and deterring fraud claims. Link

[137] CTP fraud (NSW, SIRA). Link

[138] Transport Accident Commission. Annual Report 2023-24. https://www.tac.vic.gov.au/__data/assets/pdf_file/0011/892415/TAC-Annual-Report-2024.pdf

In defining how EDR data is presently used, this chapter provides a basis for defining a benefits framework that can be used in assessing the likely benefit(s) to Australia of adopting a mandate for EDR data for vehicles at first supply into the Australian market.

It is evident that EDR data plays an invaluable role by enabling and enhancing:

- Academic research, in the following areas (but not limited to):
- The operation and optimization of passive safety systems, including ensuring that airbags deploy appropriately and seat belts (restraints) function in an optimal manner.
- Advanced Automatic Crash Notification Systems (eCALL).
- Police Crash Investigations.
- Insurance investigations, including those conducted by the Motor Vehicle Insurance industry and statutory providers of compulsory third party (CTP) insurance.

From the discussion of each 'use case', it is evident that the benefits are only realised once that data is accessed, which by definition requires a crash to have occurred. With this in mind and given the way the accessed EDR data is used, it is difficult to arrive at a single financial benefit estimate that can be directly attributed to an EDR mandate. What is clear, however, is that EDR plays an essential role in facilitating a range of secondary use cases, beyond its dynamic role as an enabler of vehicle safety systems including the deployment of airbags and the initiation of emergency response through automatic crash notification systems. Valuing the impact of academic research through its role in influencing road safety policy decisions and providing support to decision-makers, particularly with respect to supporting speed limit settings and speed enforcement programs, is likely only possible through a qualitative lens.

5. DISCUSSION

5.1 FINDINGS RELATING TO USE OF EDR DATA

This *Report* set out to establish a framework that can be used in the conduct of future regulatory impact assessment of a mandate for EDR systems, including identifying anticipated benefits of a mandate and associated costs. The findings of the research are intended to be used as inputs to any regulatory analysis of an EDR mandate under Australian Design Rules (ADRs) that may be conducted in the future.

The *Report* examined currently available EDR regulations, with particular emphasis on UN R 160 (light passenger vehicles) and UR 6 169 (heavy duty vehicles) given the stated preference of the Australian Government to harmonise its Australian Design Rules (ADRs) with the UN standards. Notably, the provisions of UN R 169 (heavy duty vehicles) are such that signatories to the 1958 Agreement on Uniform Requirements for Vehicles are not obliged to implement the *regulation* as currently written; nonetheless, this *Report* describes the requirements and data points in detail as a comparison to UN R 160 (including 01 Amendments).

Alternative regulations, including the enacting EU regulations, were also examined. While the US Regulation 49 CFR Part 563 contained specific provisions to ensure that EDR data was available to commercial providers for the purpose of developing technology to facilitate access and enable interpretation of EDR, the EU Delegated Regulations were somewhat less prescriptive. This is important to address in the Australian market as it is clear that the broad value of EDR data is entirely dependent on its use. This first requires that the vehicle is involved in a crash of sufficient severity that the defined severity triggers are met to record an event and lock the data as part of the non-volatile EDR memory, and second, the EDR data can be accessed. Understanding this point concerning benefits realisation is important when developing a regulatory impact assessment for a mandate of EDR data specifications at first supply.

Before defining points of benefit of EDR data, it is first useful to understand the present situation in Australia concerning EDR fitment, access, and EDR data ownership.

First, EDR data is stored within the Airbag Control Unit of passenger vehicles (M1, N1) and within the Engine Control Module (ECM) of heavy-duty vehicles. Trucks and buses are different as they integrate engine power sensors with the rest of the chassis control sensors; traditionally, these vehicles have also lacked airbags.

It is also apparent that as vehicle ADAS technology evolves, so too will EDR regulations. That 02 Amendments are already being considered for UN R 160 in the WP.29 EDR/DSSAD Informal Working Group (IWG) demonstrates this point. It is also asserted here that while the Data Storage System for Automated Driving (DSSAD) is a different device with a different functional purpose, its complete independence from EDR technology appears to be becoming less evident over time.

Second, due to the requirement of vehicles to meet ADR 69 (frontal crash protection), ADR 73 (UN R 94) (frontal offset), ADR 72 (UN R 95) (lateral impact), and ADR 85 (UN R 135/ GTR 14), light passenger vehicles in the M1 and N1 category have airbags fitted. By definition, these vehicles also have an Airbag Control Unit (ACU) where the EDR and associated data is stored. It is therefore necessary to consider only the incremental costs in meeting any EDR mandate.

Third, due to the absence of any uniform requirements on the data points included in an EDR record, event data differs across manufacturers where this data is available for download.

Fourth, due to the lack of legislative requirements that force manufacturers to provide the necessary technical specification information to allow EDR data to be a) read and b) interpreted, it is not possible to access EDR data for many Australian vehicles. Our analysis showed that 30% of MY 2000 and newer crash-involved vehicles had a readable EDR, and only 57% of 2024 new vehicle sales had a readable EDR using currently available crash data retrieval systems. This is a severe constraint for benefits to be fully realised and will need to be addressed in any future ADR. Any future regulatory analysis would ideally take into consideration the number of new vehicles sold that have a readable EDR in this business-as-usual scenario.

As a data input, we note that while commercial systems are costly ($10,000 to $15,000) to purchase, this is small relative to the expense of sending a single EDR device overseas to be read by a manufacturer (€4000 (AUD $6,477[139] per Unit excluding freight). From the perspective of MUARCs role in conducting academic research, sending a single EDR device overseas is cost prohibitive and would not be done unless specifically funded to do so as part of a research grant.

[139] Exchange rate, 1 EUR = 1.61931 AUD; interbank rate (xe.com).

Fifth, the EU EDR regulations and the US voluntary standard are clear that EDR data include only a short time period pre-crash, and expressly excludes driver details, date, time, location of the crash (GPS co-ordinates), vehicle VIN, and any audio and video recording external or internal of the vehicle. This is done to ensure that the EDR cannot be used to track or monitor drivers; rather, these exclusions preserve the original intent that the EDR data is used as design to assess the performance of a vehicle in a crash and is of value in the operation of the vehicle itself. Secondary use cases for EDR data have emerged, including for academic research, police investigations, and insurance-led investigations. In both the EU and the US, protection and ownership status of EDR data is clear in legislation. Specifically, within the EU EDR data is covered the General Data Protection Regulation (GDPR)[140] while in the US ownership (i.e., vehicle owner, lessee of the vehicle) and access rights are covered by the Federal *Driver Privacy Act of 2015*[141], with State-based legislation in 17 US States requiring consent of the driver to for EDR data to be accessed, noting some exceptions. US Courts have also made rulings requiring driver consent to access the EDR data, or consent of the holder of the vehicle insurance policy. This is because the information contained, if locked event data, relates to the behaviour of a specific driver at the time of a crash.

In Australia, the law appears to be silent on ownership of the EDR data, however as it is a feature of the vehicle standard property rights are taken to apply; that is, the EDR data belongs to the vehicle owner. Consequently, and consistent with the EU and the US, MUARC interprets this to mean that the consent of the vehicle owner is required to access the EDR data, noting that exceptions are appliable only to the Police due to their comprehensive powers. As stated, insured drivers have obligations to insurers to provide all required consents to the insurance company (including CTP insurance) for the purposes of claim assessment.

For other uses, including for instance, academic research, it is taken that provisions of the *Privacy Act 1986 (Cth)* would apply, as would any Commonwealth or State-based *Acts* relating to health or other sensitive information. In these instances, both the consent of the vehicle owner and driver (if different) would appear to be needed to access directly EDR data from the vehicle. Further, for the conduct of academic research, approval of a researchers institutional ethics committee would be required, including for secondary use of EDR data (e.g., where initially collected by police).

Based on the above points, any mandate would ideally be accompanied by legislative amendments that define the scope of EDR data ownership, access rights, the need for driver consent and exemptions that apply only to statutory authorities. Another final point is who owns the EDR data once the vehicle is sold, in the rare instance of event data remaining intact on the EDR that relates to a prior owner.

The above points highlight the complexity of inputs into mandating EDR regulations in Australia (and elsewhere). The following section aims to present a benefits framework so that a future regulatory impact assessment may be undertaken.

5.2 FINDINGS ON THE SAFETY USE CASE, BENEFITS, AND COSTS ASSOCIATED WITH EDR FITMENT IN AUSTRALIA

A number of use cases for EDR data and benefits associated with its use were identified, as outlined in the previous chapter. This includes:

- Enabling academic research across a range of areas, but principally as it relates to understanding the role of speed as a contributing factor to crashes and as a predictor of injury.
- As an enabler of Advanced Automatic Crash Notification Systems (eCALL).
- Enabling the operation and optimization of passive safety systems, including ensuring that airbags deploy appropriately and seat belts (restraints) function in an optimal manner.
- As an objective input to Police Crash Investigations and those conducted by the insurance sector (including CTP insurance) for the determination of benefits.
- Insurance investigations, including by the Motor Vehicle Insurance industry and statutory providers of compulsory third party (CTP) insurance.

Quantifying identified benefits from use of EDR in financial terms is challenging, particularly where the focus of use is from a research perspective. However, our analysis does show that access to EDR data saves police approximately $4,400 per crash in crash investigation costs, with this being somewhat higher for investigations conducted by the private sector forensic investigators employed by insurers (approximately

[140] EU. Regulation (EU) 2016/679. https://gdpr-info.eu/

[141] US Congress. S.766 - Driver Privacy Act of 2015. https://www.congress.gov/bill/114th-congress/senate-bill/766/text

$6,250 per crash). This does not include the significant savings to insurance companies by proving fraudulent claims, the amount of which depends on the value of the insured vehicle.

We also note that the fitment of EDR devices is now routine in vehicles. This is due to its role in enabling the deployment of airbags and seatbelt restraints, and links to eCALL / ACN systems. While not formally required to meet Australia's current performance-based occupant protection standards, the fitment of airbags with appropriate seatbelt pretensioners is the principal way for vehicles to pass type approval. Likewise, to be awarded a 5-star ANCAP safety rating these features are required.

We further note that the EDR data enables automatic crash notification systems. For this reason alone, there is support for the mandate of EDR systems to a common standard. That the UN R 160 01 Amendment includes a data point for AACN (e-Call) status indicates the interdependency of these two systems. It is widely recognised that eCALL will save lives and improve outcomes for injured vehicle occupants due to the provision of rapid medical treatment; indeed, eCALL was shown beneficial by MUARC for rural crashes in particular as far back as 2008.[142] More recently, the MUARC *Enhanced Crash Investigation Study (ECIS)* demonstrated that eCALL would have been of direct and significant benefit to 5.5% of serious injury crashes where crash notification was delayed and/or there was difficulty locating the vehicle due to problems of access in remote locations.[143]

Given the current standard fitment of Airbag Control Units (ACU) that hold the EDR data device (i.e., memory card), from an implementation cost perspective it can be argued that only the incremental cost of changes to EDRs that are presently fitted to meet any ADR (i.e., UN R 160 01 Amendments) applies. As these extra data points relate to vehicle sensors already fitted to the vehicle, the cost is likely to be negligible. As a reference, in the original text of US CFR 563, NHTSA estimated an incremental cost to be $USD 0.17/per vehicle in 2006.(p.23).[144] It could be argued that the incremental compliance cost average across all vehicles is similarly negligible in Australia in 2024, and perhaps not more than $3 to $5 per vehicle unit (at its highest) due to the need for a larger SD memory card, software integration, and meeting the costs associated with the type approval process.

The compliance costs for heavy-duty vehicles to comply with UN R 169 are likely to be higher. This is due to the likely need to consolidate the full range of data points into a single Engine Control Module (ECM). Whether this applies to newer trucks and buses that now fitted with airbags requires quantification.

Considerations and limitations associated with accessing EDR data in Australia are described. From a cost perspective, we note that commercial systems used to read EDR data range in price from $10,000 to $15,000, with annual software licensing fees payable. Access to EDR data on the bench – and not from the vehicle OBD2 port that uses a standard connection – requires that specific cables are purchased. Due to lack of requirements in Australia pertaining to the access and interpretability of EDR data, the coverage of Australia's vehicle parc is limited.

Adoption of UN R 160 01 and UN R 169 remains important due to the mix of vehicles imported to Australia. Doing so would ensure consistency of EDR data points across all vehicles sold in Australia and would ensure that driver privacy is protected. In addition, specific legislative provisions aimed at ensuring manufacturers provide the necessary specifications to access and interpret EDR are required. Legislative clarification of ownership of EDR data and owner / driver consent requirements to access and use EDR data, as has been done in the EU and the USA, represent important elements of any future mandate. These protections will be important to achieving public support for any future EDR mandate. The administrative cost of these broader legislative changes to legislation must, however, be considered.

[142] Lahausse, J. A., Fildes, B. N., Page, Y., & Fitzharris, M. P. (2008). The potential for automatic crash notification systems to reduce road fatalities. Annals of advances in automotive medicine. Association for the Advancement of Automotive Medicine. Annual Scientific Conference, 52, 85–92.

[143] Fitzharris, M., Pok Arundell, T., Corben, B., Lenné, M., Liu, S., Peiris, A., Stephens, A. N., Bowman, D., Morris, A., & Tingvall, C. (2022). Identification of countermeasures to address serious injury crashes, ECIS Report 4 (MUARC Report 346). Monash University. https://doi.org/10.26180/23305388

[144] Department of Transportation National Highway Traffic Safety Administration. 49 CFR Part 563 [Docket No. NHTSA-2006-25666]. RIN 2127-AI72. Event Data Recorder. https://www.nhtsa.gov/sites/nhtsa.gov/files/edrfinalrule_aug2006.pdf

5.3 ESTABLISHMENT OF A BENEFITS FRAMEWORK

EDR data was originally intended to be used by vehicle manufacturers as an input to examine the crash performance of their vehicles and to optimise the performance of vehicle safety systems. The value of EDR data for crash investigations conducted by police and the insurance industry, as well as facilitating academic research previously not possible was quickly recognized. This *Report* sought to identify the range of uses and associated benefits of EDR data. The project method consisted of document review of current regulations and associated legislation, technical materials from the WP 29 EDR/DSSAD Working Group on EDR devices, current *Standards,* the peer reviewed academic and grey literature (i.e., reports), and consultation with experts in the field. Taking this comprehensive approach, in our view, provides the best opportunity to identify current uses of EDR data when seeking to define the benefits of being able to access and use EDR data.

Table 5.1 provides the EDR benefits framework developed in the course of this project. It is anticipated that this framework could be used in any future regulatory impact assessment of an EDR mandate in Australia.

For each use case benefits in financial terms are derived where possible; in the absence of direct financial benefits being estimated, an explanation as to how the benefits regarding the use of EDR data can be expressed is provided. Dependencies on the access to and the use of EDR data are also specified for each use case. Considerations regarding the cost of implementing an EDR mandate are also described.

TABLE 5.1 EDR BENEFITS FRAMEWORK: SUMMARY OF USE-CASES AND ASSOCIATED BENEFITS THAT CAN BE DERIVED FROM THE USE OF EDR DATA.

BENEFITS OF USE
EDR data as an enabler of academic research
• By providing objective pre-crash and crash data metrics, EDR data is an enabler of academic research. EDR data gives researchers insight into pre-crash road user behaviour (i.e., speed, braking, steering), crash severity (i.e., impact speed, delta-V), the performance of vehicle passive safety systems (e.g., airbags), and the function of vehicle Advanced Driver Assistance Systems (ADAS) immediately prior to, and during crashes. • In the absence of EDR data, researchers must use multiple data points to derive estimates of relevant parameters (e.g., seat belt use, pre-crash travel speed).
• Research topics facilitated or enabled by EDR data include: o Estimation of injury probability curves by impact direction and impact speed, for use in speed limit setting and vehicle safety countermeasure design. o Ensuring the appropriate activation of automatic crash notification systems. This ensures emergency services are contacted when required and prevents the over triage of uninjured road users. o Establishing the proportion of crashes where exceeding the speed limit was a contributing factor, for use in speed limit setting, developing enforcement programs, and estimating the benefits of Intelligent Speed Assist (ISA) technology. o Establishing the crash risk associated with travel speed in case-control speed crash risk studies, for use in developing enforcement programs and quantifying the benefit of speed limit compliance. o Establishing the proportion of crashes where seat belts are not used. This knowledge can then be used to develop enforcement programs, develop seat belt warning systems, and appropriate regulations, and to optimise airbag performance. o As an input to understanding crash and injury causation, and the validation of contributing factors. This insight can inform road safety policy and programs. o Estimating crash severity for motorcyclists by accessing the EDR data of the striking vehicle. This data is invaluable as there is little objective data of the impact speed and crash severity for powered two-wheelers (PTW). This knowledge can be used to improve motorcycle design and motorcyclist protective equipment. o Validation of crash reconstruction processes, which in turn are used to estimate key pre-crash and crash metrics. This data can then be used as the basis for 'what-if' scenarios (e.g., lower speed, earlier braking, effect of ADAS technology). Along with understanding pre-crash manoeuvres, these outputs (including EDR data) can inform the development of new active safety systems, NCAP protocols and regulations. o EDR data points (e.g., impact speed, delta-V) can also be used to statistically adjust for crash severity when i.) assessing the real-world safety performance of vehicles ii.) when evaluating the benefits of vehicle regulations, including for instance Australian Design Rules, and iii) examining differences in injury outcomes across crash (e.g., impact direction) and occupant parameters (e.g., age, sex).

Quantification of financial benefits
• Unable to quantify the benefits of research using EDR data in financial terms due to the difficulty of directly linking research findings to road safety policy and regulations, other than to state that research findings inform the development of road safety strategies and action plans (e.g., speed limit settings), as well as vehicle-based passive and active safety systems.
• Benefits best described in qualitative terms of facilitating academic research by being able to address specific research questions with objective data as it relates to vehicle control (e.g., speed, impact speed) and other driver behaviours (e.g., use of seat belts, cruise control) pre-crash. Objective data provides greater confidence in the research findings. Parameters derived from EDR technology can be used directly in analysis or to inform and/or validate computer-based crash reconstruction.
• Time saving benefits associated with computer-based crash reconstruction in an academic research context was estimated to range from 4 – 6 days, translating to a financial saving of between AUD$ 3,863 to AUD$ 5,794 (2024 values).
Dependencies
• There are two dependencies on the use of EDR data for academic research: 1. A crash, or trigger event of sufficient severity, must occur for the EDR data to be locked. 2. The EDR data must be downloaded in an interpretable manner. ▪ In Australia, this *Report* estimates that 30% of crash-involved vehicles manufactured since 2000 have a readable EDR using commercially available crash data retrieval tools, and further, 57% of new car sales in Australia in 2024 have a readable EDR using commercially available crash data retrieval tools. ▪ The costs of Crash Data Retrieval (CDR) equipment can be high. • Researchers must also obtain approval of a Human Research Ethics Committee, or similar regulatory oversight body, for use of EDR data. Consent of the vehicle owner is also required when researchers are directly accessing the EDR data.
EDR data as a mechanism for the design and assessment of passive and active safety performance in vehicles
• Noted in the US EDR Regulation, the use of EDR data by manufacturers to optimise vehicle safety is a critical use case. Manufacturers can source EDR data through their own crash investigation programs and laboratory sled tests; manufacturers can then use this data in computer simulations when designing new vehicles. Manufacturers may also rely on researchers to collect EDR data on their behalf, as well as using findings published in academic research papers and commissioned reports.
• Research topics include: o Optimisation of airbag and seat belt performance. o Optimisation of the passive safety structure of the vehicle. o Optimisation of active safety systems, particularly the timing of automatic braking, and activation of eCALL / Automatic Crash Notification systems. o Validation of computer-based vehicle models and human body models that are used in the design of vehicles.
Quantification of financial benefits
• Unable to quantify the direct benefits of the ‘value add’ from use of EDR data in the vehicle design process in financial terms. Best stated qualitatively as giving manufacturers access to objective vehicle-based data that is used in the design of vehicles and vehicle safety systems.
Dependencies
• Manufacturers conducting their own research and development (R&D) work have no barriers to EDR data access for work done in-house. • Manufacturers may rely on published academic research to inform their internal work. Alternatively, manufacturers may commission academic researchers to investigate crashes, in which case the dependencies with regard to EDR data access would apply.

EDR as an enabling technology: informing the provision of emergency medical care through automatic crash notification

- The activation of eCALL depends on the dynamic assessment of crash severity and other events detected by vehicle sensors, including hard braking and deceleration. The EDR dynamically captures relevant data points from crash and other vehicle sensors. Using this information an algorithm included in the Airbag Control Unit determines whether a crash or other deceleration trigger is met. Once a trigger event threshold is met, the airbag ignition signal (or other trigger signal) is sent to the eCALL system. At this point, the EDR event data is locked. The automatic call to emergency services, which is the primary function of eCALL, occurs once this trigger activation is received by the fitted eCALL system. For this reason, the Airbag Control Module and the included EDR are an integral part of the eCALL function. Whether the eCALL function has been triggered is recorded by the EDR.
- Note: the fitment of an Airbag Control Unit and included EDR is independent of, and pre-dates, the fitment of eCALL systems.

Quantification of financial benefits

- The benefits associated with eCALL can be quantified and can in part be attributed to the EDR.
- Based on in-depth crash investigation data, MUARC estimated that eCALL would have been of direct benefit to 5.5% of serious injury crashes by ensuring more rapid emergency care. With regard to preventing fatalities, in 2008 MUARC estimated that eCALL would result in 104 fewer fatalities on Australian roads per annum, with this being cost-beneficial. CASR estimated that Automatic Crash Notification (ACN) would result in between 2.2% to 4.4% fewer fatalities per annum.

Dependencies

- Applicable only in the event of a crash and where eCALL is fitted to a vehicle and is supported by the local emergency management system or facilitated by a third-party service.

EDR data as a facilitator of police forensic investigations

- The investigation of crashes and the prosecution of road users committing wrongdoing is a key responsibility of police. EDR data can play a significant role in the reconstruction of crashes. EDR data provides police with objective pre-crash data across a range of parameters, as well as useful post-crash crash severity information. The objective nature of the EDR data means that the findings of crash reconstructions and police investigations are extremely robust.
- EDR data is used within the *Brief of Evidence* when bringing charges against a road user. Police also use a variety of data points and evidence in addition to the EDR data. EDR data has been accepted by the Courts as being valid.

Quantification of financial benefits

- Time and cost savings for police to investigate crashes by having access to EDR was estimated to be 3 days on average, translating to a saving of $AUD 4,404 per crash investigation.
- Efficiencies gained would also permit police to investigate additional crashes and/or to perform other duties, or to take leave.

Dependencies

- The investigation of crashes is the focus; hence, a crash must occur.
- Police have significant powers to obtain EDR data and do not require the consent of the vehicle driver to do so.

EDR data as a facilitator of motor vehicle insurance forensic investigations

- Insurance companies contract forensic experts to investigate crashes where insurance fraud is suspected. Close to 18,000 motor vehicle insurance claims are investigated in Australia each year.
- Forensic experts can use EDR data to validate the insurance claim, in addition to other available information. EDR data provides investigators with a range of data points that can be used to validate or refute a claim. The objective nature of the data adds weight to its use. The Courts have accepted the use of EDR data by insurance companies.

Quantification of financial benefits

- Following advice from a highly qualified engineer who conducts contract work for the insurance industry, the time saving by having access to EDR data in the investigation of crashes is approximately 5 days; in financial terms this equates to an average, per case saving, of $6,250 (2024).
- The estimated financial saving noted above does not include savings to the insurer from litigation that is avoided, the payout of otherwise fraudulent claims, or Court time.

Dependencies

- Requires a crash to have occurred, an insurance claim to be lodged, with this claim flagged for investigation.
- Under the terms of insurance policies, drivers and vehicle owners must provide all relevant information and consents to the insurance company for the investigation of a claim. This consent, as stipulated in the insurance products *Product Disclosure Statement* covers access to and use of EDR data.

EDR data as a facilitator of third-party injury and statutory compensation schemes decision-making

- Road users injured in crash can make a claim to statutory third-party insurers (i.e., compensation schemes, CTP) for medical and like expenses, loss-of-income, other supports, and lifetime care where appropriate for injuries sustained in crashes. Access to impairment benefits and Common Law resolutions may also apply, depending on the level of impairment, and in the latter case whether an at-fault road user can be identified. Entitlement to select benefits may also be limited depending on the nature of an offence, if any, that led to the crash.
- Third-party compensation schemes have robust systems in place to validate the claims of injured road users.
    - Police reports can be accessed directly. As noted above, Police forensic investigators can use EDR data when conducting these investigations; these investigations seek to establish wrong-doing on the part of a crash-involved person. Use of this information is important for third-party insurers.
    - Third-party insurers may access motor vehicle insurance information, inclusive of any crash investigation conducted (see above).
    - Third-party compensation schemes directly contract the services of forensic investigators in the same way as the motor vehicle insurance sector (see above).

Quantification of financial benefits

- Third-party insurers can be a beneficiary of EDR data first being used by Police or Motor Vehicle Insurers. Use of this information has significant efficiencies for the resolution of claims and the avoidance of fraud. The dollar value of these savings is not quantified here, however.
- Cost savings associated with CTP-initiated crash investigations would mirror that of motor vehicle insurers.

Dependencies

- Requires a crash to have occurred and a CTP claim to be lodged.
- The CTP provider has the right to all information, including EDR data, as a condition of the claim being made.

COSTS ASSOCIATED WITH AN EDR MANDATE AND CONSIDERATIONS

- As a reference point, in 2005 NHTSA estimated a cost of $USD 0.17 cents per vehicle to meet the US Regulation. This low dollar value was due to the fitment rate of 64% of EDRs in vehicles at that time.
- While the fitment of EDRs in passenger vehicles is now universal due to airbag fitment, costs associated with meeting uniform data requirements and other compliance costs need to be derived but are likely to be low. It could be argued that the incremental compliance cost average across all vehicles is similarly negligible in Australia in 2024, and perhaps not more than $3 to $5 per vehicle unit (at its highest) due to the need for a larger SD memory card, software integration, and meeting the costs associated with the type approval process.
- Costs associated with HVEDR are not quantified but are likely to be low given that data systems are universally implemented via heavy vehicle diagnostic systems.
- With future regulations ideally including data ownership, privacy, and access provisions, costs associated with these provisions need to be considered.
- Costs associated with downloading EDR data by academic researchers, police, and insurance, whilst worth noting, do not feed into the regulatory compliance costs and hence, ought not to be included as a cost in the assessment of a mandate. Having said this, estimates of the staff costs associated with the retrieval of EDR data were calculated and were seen to be nominal. Costs were seen to range from $55-$94 for Police and Researchers and $78-$113 for insurance-led forensic investigations; costs vary due to the method used to access EDR data, with this based largely on the extent of vehicle damage post-crash.
- Costs associated with the purchase of crash data retrieval systems (including cables, software licence) are described in the Report.

5.4 COMMENT ON THE INTERPRETATION AND USE OF THE FINDINGS

The findings reported here are intended to be used to inform a future regulatory impact assessment regarding the mandate of EDR devices for Australian vehicles at first supply. The authors have made every effort to provide objective evidence concerning the current uses of EDR data, as well as likely benefits where they can be defined.

Whether, and how, the findings of this *Report* are used in any future regulatory impact assessment by other experts is beyond the control of the authors, as is the decision to conduct the said regulatory impact assessment. We note that any decision to mandate EDRs rests solely with the Australian Government.

5.5 CONCLUSION

Recognising the non-traditional vehicle safety technology that EDR data represents, this *Report* set out to establish a benefits framework for use in a future regulatory impact assessment of an EDR mandate. It is clear from this *Report* that while the technical regulations are complex, as is the implementation of EDRs in vehicles itself, the data provided by EDR technology is of significant value across a range of use cases. Having said this, benefits realisation is first dependent on a crash occurring and then the data being accessed. The status of EDR data being used as an enabler of other activities further complicates the financial quantification of benefits. Having said this, clear time saving benefits emerge in police investigations, with police findings also being of significant of value to CTP insurers in the assessment of claims and attribution of at-fault status for the purpose of common law compensation actions.

The secondary use of police collected EDR data by academic researchers further enhances the value equation of EDR data. While this is the case, it is nonetheless difficult to quantify with any precision the financial benefits that flow from academic research that influences road safety policy or evaluates current vehicle design rules and safety countermeasures. Doing so would require first an assessment of the benefit of the implemented road safety policy in question, after which it would be necessary to attribute a fraction of the decision to implement the initiative to the foundational knowledge established by using the EDR data. With this complexity in mind noting these beneficial use cases in a qualitative manner, as NHTSA did when introducing 49 CFR 563, may be the only alternative.

Finally, implementation of a single common EDR regulation would serve to standardise data points across all vehicles. With learnings drawn from elsewhere, addressing issues of EDR data access and interpretability, as well as data ownership and privacy, is not only feasible but is necessary to overcome the current limitations in making full use of EDR data in Australia. Taking these steps is important to ensure that maximum benefits of EDR data are realised. It is hoped that the findings of this *Report* will serve as useful input to decision making as it relates to implementing mandatory EDR requirements in Australia in the future.

6. APPENDIX 1: UN REGULATIONS ON EDRs

This Appendix provides details of the key features, requirements, applicability, and data elements for UN Regulation 160 (including Amendments) and UN Regulation 169 (*Section 6.1)*. A glossary for the data elements included within UN R 160 (*Section 6.2*). and UN R 169 (*Section 6.3)* is also provided

6.1 COMPARISON OF UN R 160 (EDR FOR LIGHT VEHICLES) & UN R 169 (EDR FOR HEAVY VEHICLES)

To facilitate comparisons between UN R 160 (EDR, light vehicles) and UN R 169 (EDR, heavy vehicles) to be made, key features and specifications of both regulations are provided in Table 6.1. Table 6.2 provides the *Data Elements* included in UN R 160 and UN R 169.

With respect to UN R 160, the 01 Amendments are included and are shaded as grey. This was done to highlight a) how the EDR regulation for light vehicles has evolved, and b) how the 01 Amendments bring UN R 160 into line with the more recently developed UN R 169 (heavy vehicles), although some differences remain.

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TABLE 6.1 KEY FEATURES AND SPECIFICATIONS OF UN REGULATIONS PERTAINING TO EDR

PARAMETER	UN R NO. 160† (LIGHT: M1, N1)	UN R NO. 169‡ (HEAVY: M2, M3, N2 N3)
Purpose of regulation	To ensure that EDRs record, in a readily usable manner, data valuable for effective crash investigations and for analysis of safety equipment performance (e.g., advanced restraint systems). These data will help provide a better understanding of the circumstances in which crashes and injuries occur and will facilitate the development of safer vehicle designs.	To ensure that EDRs record, in a readily usable manner, data valuable for effective crash investigations and for analysis of safety equipment performance while limiting, to the greatest extent possible, the recording of data unrelated to the crash. Data will aid in understanding the circumstances in which crashes and injuries occur and will facilitate the development of safer vehicle designs. In scope crashes include those resulting in property damage and/or personal harm, including those involving vulnerable road users (VRU).
Requirements	Minimum collection (data elements, data format), capture / storage, crash test performance and crash survivability of motor vehicle crash event data.	Minimum collection, storage, and crash survivability of the motor vehicle crash event data.
Applicability	M1 and N1 Vehicles.	M2, M3, N2 and N3 vehicles. Note: States that, *Contracting Parties* may but are not required to make EDR requirements mandatory for M2, M3, N2 and N3 vehicles.
Does not include	It does not include specifications for data retrieval tools and methods as that is subject to national/regional level requirement. (p.4). That is, does not include uniform collection methods / tools. However, upon seeking type approval, 'Instructions for retrieving data from the EDR' are required.	It does not include specifications for data retrieval tools and methods which are subject to national or regional level requirements.
Date of entry into force as an annex to the 1958 Agreement	30 September 2021. (Note: Revision 1 – Amendment 1; '01 amendments: 8 October 2022).	19 June 2024.
Applicable from	As specified by Contracting Parties.	As specified by Contracting Parties (but not mandatory to do so).
Matters of privacy, data protection, personal data requirements	Regulation is made without prejudice to requirements of national or regional laws related to privacy, data protection and personal data processing. *That is, UN R 160 is silent on these matters.*	Regulation is made without prejudice to requirements of national or regional laws related to privacy, data protection and personal data processing. *That is, UN R 169 is silent on these matters.*
Type approval requirements	Includes specification of: ▪ Location of the EDR in the vehicle. ▪ Triggering parameters. ▪ Storing capacity. ▪ Resistance to high deceleration and mechanical stress of a severe impact (performance and survivability). ▪ Data elements and format stored in the EDR. ▪ Instructions for retrieving data from the EDR (capture).	Includes specification of: ▪ Location of the EDR in the vehicle. ▪ Triggering parameters. ▪ Storing capacity. ▪ Resistance to high deceleration and mechanical stress of a severe impact (performance and survivability). ▪ Data elements and format stored in the EDR. ▪ Instructions for retrieving data from the EDR (capture).

PARAMETER	UN R NO. 160† (LIGHT: M1, N1)	UN R NO. 169‡ (HEAVY: M2, M3, N2 N3)
Data elements	Specified (Annex 4), with exclusions stated (below).	Specified (Annex 4), with exclusions stated (below).
Data elements **excluded**	VIN, associated vehicle details, location/positioning data, information of the driver, and date and time of an event.	VIN, associated vehicle details, location/positioning data, information of the driver, and date and time of an event.
Reporting / capture	Mandatory where a relevant specified sensor is fitted and operational.	Mandatory where a relevant specified sensor is fitted and operational.
Data capture	The EDR shall record the captured data in the vehicle and this data shall remain in the vehicle, at least until they are retrieved in **compliance with national or regional legislation** or they are overwritten in compliance with other specified clauses (i.e., *conditions for triggering locking of data).* The EDR non-volatile memory buffer shall accommodate the data related to at least **<u>two</u>** different events.	The EDR shall record the captured data in the vehicle and this data shall remain in the vehicle, at least until they are retrieved in **compliance with national or regional legislation** or they are overwritten in compliance with other specified clauses (i.e., *conditions for triggering locking of data).* The EDR non-volatile memory buffer shall accommodate the data related to at least **five** different events.

Data Trigger (5.3.1)	An event shall be recorded by the EDR if one of the following threshold values is met or exceeded:
	▪ Change in longitudinal vehicle velocity more than 8 km/h within a 150 ms[b] or less interval (5.3.1.1).
	▪ Change in lateral vehicle velocity more than 8 km/h within a 150 ms or less interval (5.3.1.2).
	▪ Activation of Non-reversible occupant restraint system (e.g., airbag) (5.3.1.3).
	▪ Activation of Vulnerable Road User secondary safety system (if fitted) [#] (5.3.1.4).
		An event shall be recorded by the EDR if one of the following threshold values is met or exceeded:
		▪ Sudden Deceleration: Vehicle speed changes at a rate higher than 3.25 m/s^2 and the change persists beyond that threshold for at least 0.7 seconds.
		▪ Last Stop: Trigger shall be activated if any of the following applies: (a) Vehicle speed is reported as 0 km/h for 20 s. (b) While vehicle speed is reported as 0 km/h, and (i) parking brake system is applied, or (ii) vehicle master control switch is deactivated. Re-activation of last stop trigger due to threshold criterion (a) shall be disabled if the vehicle speed is not reported as 24 km/h or more for a minimum of 6 s.
		▪ Activation of a safety system, specifically:
		  ○ Deployment command of supplementary restraint system (airbag, pretensioners), with components defined by UN Regulation 16 (safety belts / restraint devices).
		  ○ Antilock Braking System intervention.
		  ○ Advanced Emergency Braking (including pedestrian / cyclist if fitted) intervention.
		  ○ Vehicle Stability Function system intervention.
		Triggers that occur such that an overlap of data between events would result may be excluded

PARAMETER	UN R NO. 160† (LIGHT: M1, N1)	UN R NO. 169‡ (HEAVY: M2, M3, N2 N3)
Data Locking (5.3.2)	▪ In all cases where a non-reversible occupant restraint system is deployed [5.3.2.2]. ▪ In the case of a frontal impact, if the vehicle is not fitted with a non-reversible system for front impact, when the vehicle's velocity change in x-axis direction exceeds 25 km/h within 150 ms[c] or less interval. [5.3.2.3]. ▪ Activation of Vulnerable Road User secondary safety system (if fitted).	In all the cases of supplemental restraint system was activated.
Relevant to other Regulations / crash tests	The data shall be retrievable even after an impact of a severity level set by UN Regulations Numbers 94 (frontal), 95 (lateral/side) or 137 (frontal/restraint system).	EDR's shall withstand mechanical shocks at a severity level as specified in the component test of Annex 9C of the 03 or any later series of amendments to UN Regulation No 100 (requirements for the electric power train), or The manufacturer demonstrates that data is retrievable even after an impact of a severity level set by UN Regulations Nos 94 (frontal impact) (Annex 3), 95 (lateral impact) (Annex 4) or 137 (frontal impact with focus on restraint system) (Annex 3).

†UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021]

Note (01 amendments): UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022]

‡ UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024]

Vulnerable road user secondary safety system" means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision.

[a] Subject to national/regional level requirement

[b] Approx. -1.5 g; [c] approx. -4.7 g

TABLE 6.2 DATA ELEMENTS INCLUDED UN REGULATIONS PERTAINING TO EDR

UN REGULATION NO. 160 (LIGHT VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] † [01 AMENDMENTS SHADED IN GREY]	UN REGULATION NO. 169 (HEAVY VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] ‡
Vehicle speed and control systems	
Speed, vehicle indicated (km/h) [period: -5.0 to 0 sec] [a b c]	Vehicle Speed (km/h) [period: - 20 to +10 sec] [d]
Engine throttle (% full (or accelerator pedal, % full) [period -5.0 to 0 sec] [a b c]	Accelerator Pedal Position (%) [period: - 20 to +10 sec] [d]
Ignition cycle, At Crash & At the time of download] (1 cycle resolution) [period: -1.0 sec] [a b c]	Ignition cycle, At Crash& At the time of download] (1 cycle resolution) [period: -1.0 sec] [d]
Engine rpm (0 to 10,000 rpm) [period: -5.0 to 0 sec] [a b]	Propulsion system torque (Nm) [period: - 20 to +10 sec] [d] Propulsion system power (kW) [period: - 20 to +10 sec] [d] Propulsion system drive speed (RPM) [period: - 20 to +10 sec] [d] Propulsion system activation hours: At Event (hrs); At download (hrs) (period: -1.0 sec) [d]
	Gear position status (reverse) [period: - 20 to +10 sec] [d]
	Retarder Torque Mode (Default, Operator Selection, Cruise Control, Road Speed Limit, Stability Control, Transmission Control, Engine Speed Limit, Braking System) [period: - 20 to +10 sec] [d]
Steering input (-250 degrees CW to + 250 degrees CCW) [period: -5.0 to 0 sec] [a b c]	Steering wheel angle (degrees) [period: - 20 to +10 sec] [d]
Brake status - Service (on/off) [period: -5.0 to 0 sec] [a b c]	Brake Status – Service (on/off) [period: - 20 to +10 sec] [d] Brake Status – Parking (on/off) [period: - 20 to +10 sec] [d]
Anti-lock braking system (ABS) activity (faulted, active, intervening; 01 Amendment: faulted, non-engaged, engaged) [period: -5.0 to 0 sec] [a b c]	ABS Brake Control Status – Motor vehicle (off, installed – passive; installed - active) [period: - 20 to +10 sec] [d] ABS Brake Control Status – Trailer (off, installed – passive; installed - active) [period: - 20 to +10 sec] [d]
Stability control (faulted, active, intervening; 01 Amendment: faulted, non-engaged, engaged) [period: -5.0 to 0 sec] [a b c]	Stability control system status (fully operational, not fully operational) [period: - 20 to +10 sec] [d]
Traction Control Status (Faulted, On, Off, Engaged) [period: -5 to 0.0 seconds relative to time zero] (mandatory if not fitted with ESC) [a b]	
	Yaw Control system status (on, off) [period: - 20 to +10 sec] [d]
Yaw Rate (-75 to +75 degrees) [period: - 5 to 0.0 seconds relative to time zero] [a b]	Yaw Rate (passive but installed, active) [period: - 20 to +10 sec] [d]
	Rollover Protection Control system status (passive but installed, active) [period: - 20 to +10 sec] [d]
Vehicle roll angle (-1080 degrees to + 1080 degrees) [period: -1.0 up to 5.0 sec] [01 Amendment, period: 0 to at least 250 ms] [if recorded, not mandatory] [b]	Vehicle roll angle (-1080 degrees to + 1080 degrees) [period: -20.0 to +10.0 sec] [if recorded, not mandatory] [d]

†UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].

Note (01 amendments): UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022].

‡ UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].

Note 1: UN R 160 regulation trigger events: recorded for: a. Planar; b. Rollover; c VRU.

Note 2: UN R 169 (heavy duty) trigger events: d: All triggers; e Supplemental Restraint System (SRS).

Note 3: For time-based data elements, time periods are minimum range values; For data elements with system states, the term "engaged" also means "actively controlling" or "actively intervening" and "not-engaged" also means "on but not controlling". Likewise, "off" also means "deactivated".

UN REGULATION NO. 160 (LIGHT VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] † [01 AMENDMENTS SHADED IN GREY]	UN REGULATION NO. 169 (HEAVY VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] ‡
Vehicle Roll rate (degrees) [period: 0 to at least 250 ms] [b] (rollover events)	Vehicle Roll rate (degrees) [period: - 20 to +10 sec] [e] (rollover events)
Tyre Pressure Monitoring System (TPMS) warning lamp status (on, off) [period: -1,0 seconds relative to time zero] [a b]	Tyre Pressure Monitoring System (TPMS) warning lamp status (on, off) [period: - 20 to +10 sec] [d]
Advanced Driver Assistance Systems	
Advanced emergency braking system status (AEBS) (Faulted, On, Off, Engaged) [period: - 5 to 0.0 seconds relative to time zero] [a b c]	Advanced Emergency Braking (Faulted, Off, On not warning/ intervening, On warning, On intervening) [period: - 20 to +10 sec] [d]
Cruise control system status (Engaged, Faulted, Off, Non-engaged) [period: - 5 to 0.0 seconds relative to time zero] [a b c]	
Adaptive Cruise Control (ACC) status (driving automation system level 1 (Engaged, Faulted, Off, Non-engaged) [period: - 5 to 0.0 seconds relative to time zero] [a b c]	
Lane Departure Warning (LDW) status (Faulted, Off, On but not warning, On – Warning left, On – Warning right) [period: -5.0 to 0.0 sec] [a b]	Lane Departure Warning System status (Faulted, Off, On not warning/ intervening, On warning, On intervening) [period: -20 to +10 sec] [d]
Corrective Steering function status (Faulted, Off, On but not engaged, Engaged) [period: -5.0 to 0.0 sec] [a b]	Corrective steering function status (Faulted, Off, On not warning/ intervening, On warning, On intervening) [period: -20 to +10 sec] [d]
Emergency steering function status (Faulted, Off, On but not engaged, Engaged) [period: -5.0 to 0.0 sec] [a b]	Emergency steering function status (Faulted, Off, On not warning/ intervening, On warning, On intervening) [period: - 20 to +10 sec] [d]
Automatically commanded steering function category A, B1, B2, C, D, E status (Faulted, Off, Stand-by, Active) [period: -5.0 to 0.0 sec] [a b]	Automatically commanded steering function category A, B, C, D, E status (Faulted, Off, On but not controlling, On controlling) [period: - 20 to +10 sec] [d]
Vulnerable road user secondary safety system warning indicator status (on, off) [period: event] [c]	
Vulnerable road user secondary safety system deployment, time to deploy (0 to 250 ms) [period: -1,1 to 0 seconds relative to time zero] [c]	
	Blind Spot Information System for the Detection of Bicycles (Off, Faulted, On not warning, On warning left- side, On warning right-side) [period: - 20 to +10 sec] [d]
	Reversing motion VRU detection system (Off, Faulted, On not warning, On warning left- side, On warning right-side) [period: - 20 to +10 sec] [d]
	Moving Off Information System for the Detection of Pedestrians and Cyclists (Off, Faulted, On not warning, On warning left- side, On warning right-side) [period: - 20 to +10 sec] [d]

†UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].

Note (01 amendments): UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022].

‡ UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].

Note 1: UN R 160 regulation trigger events: recorded for: a. Planar; b. Rollover; c VRU.

Note 2: UN R 169 (heavy duty) trigger events: d: All triggers; e Supplemental Restraint System (SRS).

Note 3: For time-based data elements, time periods are minimum range values; For data elements with system states, the term "engaged" also means "actively controlling" or "actively intervening" and "not-engaged" also means "on but not controlling". Likewise, "off" also means "deactivated".

UN REGULATION NO. 160 (LIGHT VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] † [01 AMENDMENTS SHADED IN GREY]	UN REGULATION NO. 169 (HEAVY VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] ‡
Occupant seating and anthropometry	
Seat track position switch, foremost, status, driver, front passenger [period: -1.0 sec] (yes or no). [a b]	
Occupant size classification, driver (if recorded/not mandatory) [period: -1.0 sec] (5th percentile female or larger: yes/no). [a b]	
Occupant size classification, front passenger (if recorded/not mandatory) (6-year-old HIII ATD or Q6 ATD or smaller: yes/no) [period-1.0 sec]. [a b]	
Restraint use, airbags, seatbelt pretensioners, eCall – Automatic Crash Notification	
Safety belt status: driver, front passenger (fastened, not) [period: -1.0 sec] [a b]	Safety belt status (position x–y) (fastened, not fastened) [period: -1.0 sec] [d]
Safety belt status: mid-position front (fastened, not) [period: -1.0 sec] [a b]	
Safety belt status: rear passengers (fastened, not) [period: -1.0 sec] [a b]	
Passenger airbag suppression status (suppressed, not) [period: -1.0 sec] [a b]	
Airbag warning lamp (on or off) [period: -1.0 sec] [a b]	
Frontal Airbag deployment (for driver & front passenger) (Multiple parameters – time-to-deploy, time-to-Nth stage if multi-stage inflator) [period: 0 to 250 ms] [a]	Frontal Airbag system status (faulted, not deployed, deployed) [period: event] [e]
Side Airbag deployment (for driver & front passenger) Time-to-deploy [period: 0 to 250 ms] [a]	Side Airbag system status (faulted, not deployed, deployed) [period: event] [e]
Side curtain / tube Airbag deployment (for driver & front passenger): time-to-deploy [period: 0 to 250 ms] [a b]	Side Curtain / Tube Airbag system status (faulted, not deployed, deployed) [period: event] [e]
Pretensioner deployment (for driver, front passenger): time-to-fire [period: 0-250 ms] [a b]	Safety belt pretensioner status (position x–y) (faulted, not deployed, deployed) [period: event] [e]
Far-side impact centre air bag deployment, time to deploy (0 to 250 ms) [period: event] [a b]	Far-side impact centre air bag system status (faulted, not deployed, deployed) [period: event] [e]
Accident Emergency Call System (AECS) status (Faulted, On but emergency call not automatically triggered, On – Emergency call automatically triggered [period: event] [a b c]	Accident Emergency Call System (AECS) status (Faulted, On but emergency call not automatically triggered, On – Emergency call automatically triggered [period: event] [e]
1) Multi-event crash, number of events (1 or more) [a b c] 2) Time from event 1 to 2 [period: 0 to 5.0 sec] (as needed) [a b]	

†UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].

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‡ UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].

Note 1: UN R 160 regulation trigger events: recorded for: a. Planar; b. Rollover; c VRU.

Note 2: UN R 169 (heavy duty) trigger events: d: All triggers; e Supplemental Restraint System (SRS).

Note 3: For time-based data elements, time periods are minimum range values; For data elements with system states, the term "engaged" also means "actively controlling" or "actively intervening" and "not-engaged" also means "on but not controlling". Likewise, "off" also means "deactivated".

UN REGULATION NO. 160 (LIGHT VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] † [01 AMENDMENTS SHADED IN GREY]	UN REGULATION NO. 169 (HEAVY VEHICLES) [ANNEX 4: DATA ELEMENTS AND FORMAT] ‡
Crash severity indices – delta V and acceleration	
Delta-V (km/h), longitudinal (-100 km/h to +100 km/h) [period: 0 to 250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a]	
Delta-V (km/h), lateral (-100 km/h to +100 km/h) [period: 0 to 250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a]	
Maximum delta-V (km/h), longitudinal & lateral (-100 km/h to + 100 km/h) [period: 0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a]	Maximum delta-V (km/h), longitudinal & lateral (-100 km/h to + 100 km/h) [period: event] [e (planar events)]
Maximum delta-V (km/h), resultant (-100 km/h to + 100 km/h) [period: event] [a]	Maximum delta-V (km/h), resultant (-100 km/h to + 100 km/h) [period: event] [e (planar events)]
Time, maximum delta-V, longitudinal & lateral & resultant [01 Amendment] a [period: 0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a]	Time, maximum delta-V, longitudinal & lateral & resultant [period: 0–300 ms] [e (planar events)]
Crash severity indices – delta V and acceleration (continued)	
Longitudinal acceleration (pre – crash) (1.5 g to +1.5 g) [period: -5.0 to 0.0 sex relative to time zero) [a c]	Longitudinal Acceleration (–1.5 g to +1.5 g) [period: - 20 to +10 sec] [d]
Longitudinal Acceleration (post-crash) (50 to +50 g) [period: 0–250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a]	
Lateral acceleration (pre – crash) (1.5 g to +1.5 g) [period: -5.0 to 0.0 sex relative to time zero) [a]	Lateral Acceleration (–1.5 g to +1.5 g) [period: - 20 to +10 sec] [d]
Lateral Acceleration (post-crash) (50 to +50 g) [period: 0–250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter] [a b]	
Normal acceleration (-5 g to +5 g) [period: -1.0 to 5.0 sec] [b] 01 Amendment: Normal acceleration (-5 g to +5 g) [period: 0.0 to at least 250 ms] [b]	
EDR trigger and write file status	
Complete file recorded (yes, no) [following other data] [a b c]	Event Data Recording Complete (%) [d]
	EDR unit hardware part number [d] EDR unit software part number [d]
	Trigger Activated (event) [d]

†UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].
Note (01 amendments): UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022].
‡ UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].
Note 1: UN R 160 regulation trigger events: recorded for: a. Planar; b. Rollover; c VRU.
Note 2: UN R 169 (heavy duty) trigger events: d: All triggers; e Supplemental Restraint System (SRS).
Note 3: For time-based data elements, time periods are minimum range values; For data elements with system states, the term "engaged" also means "actively controlling" or "actively intervening" and "not-engaged" also means "on but not controlling". Likewise, "off" also means "deactivated".

6.2 GLOSSARY OF TERMS USED IN UN R 160, INCLUDING ADDITIONAL AND MODIFIED TERMS PER THE 01 AMENDMENT (EDR FOR LIGHT VEHICLES)

TABLE 6.3 GLOSSARY FOR TERMS USED IN UN R 160

TERM	DEFINITION
ABS activity	Means the anti-lock brake system (ABS) is actively controlling the vehicle's brakes.
Air bag warning lamp status	Means whether the air bag malfunction warning lamp is on or off.
Capture	Means the process of buffering EDR data in a temporary, volatile storage where it is continuously updated at regular time intervals.
Delta-V, lateral	Means the cumulative change in velocity, as recorded by the EDR of the vehicle, along the lateral axis.
Delta-V, longitudinal	Means the cumulative change in velocity, as recorded by the EDR of the vehicle, along the longitudinal axis.
Deployment time, frontal air bag	Means (for both driver and front passenger) the elapsed time from crash time zero to the deployment command or for multi-staged air bag systems, the deployment command for the first stage.
End of event time	Means the moment at which the cumulative delta-V within a 20 ms time period becomes 0.8 km/h or less, or the moment at which the crash detection algorithm of the air bag control unit resets.
Engine RPM	Means: (a) For vehicles powered by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle's engine, and (b) For vehicles not entirely powered by internal combustion engines, the number of revolutions per minute of the motor shaft at the point at which it enters the vehicle transmission gearbox, and (c) For vehicles not powered by internal combustion engines at all, the number of revolutions per minute of the output shaft of the device(s) supplying motive power.
Engine throttle, percent full	Means the driver-requested acceleration as measured by the throttle position sensor on the accelerator control compared to the fully depressed position.
Event	Means a crash or other physical occurrence that causes the trigger threshold to be met or exceeded, or any non-reversible deployable restraint to be deployed, whichever occurs first.
Event data recorder (EDR)	Means a device or function in a vehicle that records the vehicle's dynamic, time-series data during the time period just prior to an event (e.g., vehicle speed vs. time) or during a crash event (e.g., delta-V vs. time), intended for retrieval after the crash event. For the purposes of this definition, the event data does not include audio and video data.
Frontal air bag	Means an inflatable restraint system that requires no action by vehicle occupants and is used to meet the applicable national frontal crash protection requirements.
If recorded	Means if data is recorded in non-volatile memory for the purpose of subsequent downloading.
Ignition cycle, crash	Means the number (count) of power mode cycles at the time when the crash event occurred since the first use of the EDR.
Ignition cycle download	Means the number (count) power mode cycles at the time when the data was downloaded since the first use of the EDR.

TERM	DEFINITION
Lateral acceleration	Means the component of the vector acceleration of a point in the vehicle in the y-direction. The lateral acceleration is positive from left to right, from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.
Longitudinal acceleration	Means the component of the vector acceleration of a point in the vehicle in the x-direction. The longitudinal acceleration is positive in the direction of forward vehicle travel.
Maximum delta-V, lateral	Means the maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the lateral axis.
Maximum delta-V, longitudinal	Means the maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the longitudinal axis.
Maximum delta–V, resultant	Means the time-correlated maximum value of the cumulative change in velocity, as reported by the EDR, along the vector-added longitudinal and lateral axis.
Multi-event crash	Means the occurrence of a minimum of 2 events, the first and last of which begin not more than 5 seconds apart
Non-volatile memory	Means the memory reserved for maintaining recorded EDR data in a semi-permanent fashion. Data recorded in non-volatile memory is retained after a loss of power and can be retrieved with EDR data extraction tools and methods.
Normal acceleration	Means the component of the vector acceleration of a point in the vehicle in the z-direction. The normal acceleration is positive in a downward direction.
Occupant size classification	Means, for front passenger, the classification of an occupant as an adult and not a child, and for the driver, the classification of the driver as not being of small stature as indicated in the data format.
Operational	Means that the system or sensor, at the time of the event, is active or can be activated/deactivated by the driver.
Passenger air bag suppression status	Means the status of the passenger air bag (suppressed or not suppressed).
Pretensioner	Means a device that is activated by a vehicle's crash sensing system and removes slack from a vehicle safety belt system.
Record	Means the process of saving captured EDR data into a non-volatile storage for subsequent retrieval
Safety belt status	Means the feedback from the safety system that the vehicle’s safety belt is fastened or unfastened.
Seat track position switch, foremost, status	Means the status of the switch that is installed to detect whether the seat is moved to a forward position.
Service brake, on and off	Means the status of the device that is installed in or connected to the brake pedal system to detect whether the pedal was pressed. The device can include the brake pedal switch or other driver-operated service brake control.
Side air bag	Means any inflatable occupant restraint device that is mounted to the seat or side structure of the vehicle interior, and that is designed to deploy in a side impact crash to help mitigate occupant injury and/or ejection. Note: Side air bags can also deploy in other crash modes as determined by the vehicle manufacturer.
Side curtain/tube air bag	Means any inflatable occupant restraint device that is mounted to the side structure of the vehicle interior, and that is designed to deploy in a side impact crash or rollover and to help mitigate occupant injury and/or ejection. Note: Side curtain/tube air bags can also deploy in other crash modes as determined by the manufacturer.

TERM	DEFINITION
Speed, vehicle indicated	Means the vehicle speed indicated by a manufacturer-designated subsystem designed to indicate the vehicle's ground travel speed during vehicle operation.
Stability control	Means any device that complies with national, Electronic stability control systems.
Steering input	Means the angular displacement of the steering wheel measured from the straight-ahead position (position corresponding to zero average steer angle of a pair of steered wheels).
Time from event 1 to 2	Means the elapsed time from time zero of the first event to time zero of the second event of a multi-event crash.
Time, maximum delta–V, lateral	Means the time from crash time zero to the point where the maximum value of the cumulative change in velocity is found, as recorded by the EDR, along the lateral axis.
Time, maximum delta-V, longitudinal	Means the time from crash time zero to the point where the maximum value of the cumulative change in velocity is found, as recorded by the EDR, along the longitudinal axis.
Time, maximum delta–V, resultant	Means the time from crash time zero to the point where the maximum delta–V resultant occurs, as reported by the EDR.
Time to deploy, pretensioner	Means the elapsed time from crash time zero to the deployment command for the safety belt pretensioner (for both driver and front passenger).
Time to deploy, side air bag/curtain	Means the elapsed time from crash time zero to the deployment command for a side air bag or a side curtain/tube air bag (for both driver and front passenger).
Time to first stage	Means the elapsed time between time zero and the time when the first stage of a frontal air bag is commanded to fire.
Time to nth stage	Means the elapsed time from crash time zero to the deployment command for the nth stage of a frontal air bag (for both driver and front passenger).
Time zero is	Is the time reference for the EDR data timestamps of an event.
Trigger threshold	Means the appropriate parameter has met the conditions for recording an EDR event.
Vehicle roll angle	Means the angle between the vehicle y-axis and the ground plane as determined by the sensing system.
Vehicle type with regard to its Event Data Recorder	Means vehicles which do not differ significantly in such essential aspects as: a) The manufacturer’s trade name or mark. b) Vehicle features which significantly influence the performances of the EDR; Addition of new trigger(s), new data (elements), or modification in their format, shall not be considered as significantly influencing the performance of EDR. c) The main characteristics and design of the EDR.
Volatile memory	Means the memory reserved for buffering of captured EDR data. The memory is not capable of retaining data in a semi-permanent fashion. Data captured in volatile memory is continuously overwritten and is not retained in the event of a power loss or retrievable with EDR data extraction tools.
Vulnerable road user secondary safety system	Means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision.
X-direction	Means in the direction of the vehicle’s X-axis, which is parallel to the vehicle's longitudinal centreline. The X-direction is positive in the direction of forward vehicle travel.
Y-direction	Means in the direction of the vehicle’s Y-axis, which is perpendicular to its X-axis and in the same horizontal plane as that axis. The Y-direction is positive from left to right, from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

TERM	DEFINITION
Z-direction	Means in the direction of the vehicle's Z-axis, which is perpendicular to the X and Y-axes. The Z-direction is positive in a downward direction.
Vehicle roll rate	Means the change in angle over time of the vehicle about its X-axis as determined by the sensing system.
Vehicle yaw rate	Means the change in angle over time of the vehicle about its Z-axis as determined by the sensing system.
X-direction	Means in the direction of the vehicle's X-axis, which is parallel to the vehicle's longitudinal centreline. The X-direction is positive in the direction of forward vehicle travel.
Y-direction	Means in the direction of the vehicle's Y-axis, which is perpendicular to its X-axis and in the same horizontal plane as that axis. The Y-direction is positive from left to right, from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.
Z-direction	Means in the direction of the vehicle's Z-axis, which is perpendicular to the X and Y-axes. The Z-direction is positive in a downward direction.
Vehicle roll rate	Means the change in angle over time of the vehicle about its X-axis as determined by the sensing system.
Vehicle yaw rate	Means the change in angle over time of the vehicle about its Z-axis as determined by the sensing system.

Reference: UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder. E/ECE/TRANS/505/Rev.3/Add.159, Link. Legally binding text is: ECE/TRANS/WP.29/2020/123/Rev.1. [In force: 30 September 2021].

TABLE 6.4 GLOSSARY FOR TERMS USED IN UN R 160 01 AMENDMENT

TERM	DEFINITION
Accident Emergency Call System	Means a system that is activated either automatically via in-vehicle sensors or manually, which carries, by Means of public mobile wireless communications networks, a set of crash-related data and establishes an emergency audio channel between the occupants of the vehicle and an answering point.
Adaptive cruise control	Is a system which accelerates or decelerates the vehicle to automatically maintain a driver pre-set speed and driver pre-set gap distance from the vehicle in front.
Advanced emergency braking system status	Means the operating status of a system which can automatically detect an imminent forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating a collision.
Anti-lock brake system activity	Means the anti-lock brake system is actively controlling the vehicle's brakes.
Automatically commanded steering function category A	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to assist the driver in low speed or parking manoeuvring.
Automatically commanded steering function category B1	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to assist the driver in keeping the vehicle within the chosen lane by influencing the lateral movement of the vehicle.
Automatically commanded steering function category B2	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to keep the vehicle within its lane by influencing the lateral movement of the vehicle for extended periods without further driver command/confirmation.
Automatically commanded steering function category C	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to perform a single lateral manoeuvre (e.g. lane change) when commanded by the driver.
Automatically commanded steering function category D	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to indicate the possibility of a single lateral manoeuvre (e.g. lane change) but perform that function only following a confirmation by the driver.
Automatically commanded steering function category E	Means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to continuously determine the possibility of a manoeuvre (e.g. lane change) and complete these manoeuvres for extended periods without further driver command/confirmation.
Corrective steering function	Means a control function within an electronic control system whereby, for a limited duration, changes to the steering angle of one or more wheels may result from the automatic evaluation of signals initiated on-board the vehicle, in order to compensate a sudden, unexpected change in the side force of the vehicle, improve the vehicle stability (e.g. side wind, differing adhesion road conditions µ-split), or correct lane departure (e.g. to avoid crossing lane markings, leaving the road).

TERM	DEFINITION
Emergency Steering Function	Means a control function which can automatically detect a potential collision and automatically activate the vehicle steering system for a limited duration, to steer the vehicle with the purpose of avoiding or mitigating a collision, with an obstacle obstructing the path of the subject vehicle or when the obstruction of the subject vehicle's path is deemed imminent.
Far-side impact centre air bag deployment, time to deploy	Means the deployment time of an air bag between driver and front seat passenger, relative to Time 0.
Ignition cycle, crash	Means the number (count) of power mode cycles as determined by the EDR ECU at the time when the crash event occurred since the first use of the EDR.
Ignition cycle download	Means the number (count) of power mode cycles as determined by the EDR ECU at the time when the data was downloaded since the first use of the EDR.
Lane Departure Warning System	Means a system to warn the driver of an unintentional drift of the vehicle out of its travel lane.
Rollover	Means any vehicle rotation of 90 degrees or more about any true longitudinal or lateral axis.
Tyre Pressure Monitoring System	Means a system fitted on a vehicle, able to perform a function to evaluate the inflation pressure of the tyres or the variation of this inflation pressure over time and to transmit corresponding information to the user while the vehicle is running.

Reference: UN Regulation No 160 – Uniform provisions concerning the approval of motor vehicles with regard to the Event Data Recorder – Revision 1 – (01 series of amendments), E/ECE/TRANS/505/Rev.3/Add.159/Rev.1/Amend.1, Link (amendments 01 supplement only); (Link, full text including 01 amendments). Legally binding text is: ECE/TRANS/WP.29/2022/26. [In force: 8 October 2022].

6.3 GLOSSARY OF TERMS USED IN UN R 169 (EDR FOR HEAVY VEHICLES) [2024/1218]

TABLE 6.5 GLOSSARY FOR TERMS USED IN UN R 169

TERM	DEFINITION
Accelerator pedal position	Means the actuation of the device that indicates the drivers demand for acceleration to the propulsion system given in percentage of measured range of the device. This can also cover one pedal drive that may be demanding negative torque or even service braking in lower ranges.
Antilock braking system	Means a system which detects wheel slip and automatically modulates the pressure producing the braking forces at the wheel(s) to limit the degree of wheel slip.
Antilock brake system status – tractor	Indicates the status of the antilock brake system on the vehicle/tractor.
Antilock brake system status – trailer	Indicates the status of the antilock brake system on trailer(s).
Advanced emergency braking system means	A system which can automatically detect a potential forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating a collision. The system may also be referred to as Automatic emergency braking system in other publications or countries.
Brake status parking	Indicates the status of the switch that is installed to detect whether or not the parking brake has been applied.
Brake status service	Indicates the status of the switch that is installed in the brake system to detect whether the service brake has been applied.
Vehicle stability function	Means vehicle stability control as defined by UN Regulation No 13. The system may also be referred to as Electronic Stability Control in other publications or countries.
Propulsion system activation hours	Means the accumulated time that the propulsion system is activated including idle state.
Propulsion System Torque	Means the percentage of peak or reference torque.
Propulsion System Power	Means the instantaneous power provided by the propulsion system.
Propulsion system drive speed	Means the rotational speed of the output shaft of the propulsion system.
Event	Means a crash or other physical occurrence that causes the trigger threshold to be met or exceeded.
Event Data Recorder (EDR)	Means a device or function in a vehicle, the purpose of which is to record the vehicles dynamic, time-series data during the time period just prior to, during, and after an event (e.g. vehicle speed versus time).
Event data recording complete	Indicates whether a complete set of data that the event data recording device is designed to capture was successfully recorded by and stored in the device.
End of event time	Means the moment at which the cumulative change in velocity within a 20 ms time period becomes 0.8 km/h or less, or the moment at which the crash detection algorithm of the air bag control unit resets.
EDR unit hardware part number	Means the part number for the EDR unit.
EDR unit software part number	Means the part number/version number for the EDR software.

TERM	DEFINITION
Ignition cycle, event	Means the number (count) of power mode cycles as determined by the EDR ECU at the time when the event occurred since the first use of the EDR.
Ignition cycle, download	Means the number (count) power mode cycles as determined by the EDR ECU at the time when the data was downloaded since the first use of the EDR.
Lane departure warning system status	Indicates the status of the lane departure warning system.
Maximum delta-V, longitudinal	Means the maximum value of the cumulative change in velocity along the longitudinal axis of the vehicle within a time period of 300 ms after time zero or before the end of event time plus 30 ms, whichever is shorter.
Maximum delta-V, lateral	Means the maximum value of the cumulative change in velocity along the lateral axis of the vehicle within a time period of 300 ms after time zero or before the end of event time plus 30 ms, whichever is shorter.
Maximum delta-V, resultant	Means the time-correlated maximum value of the cumulative change in velocity, as reported by the EDR along the vector-added longitudinal and lateral axis.
Time for maximum delta-V	Means the time from time zero to the point where the maximum value of the cumulative change in velocity, as recorded by the EDR, is found.
Retarder torque mode	Indicates which function is currently generating, limiting, or controlling the retarder torque.
Retarder torque mode	Retarder torque mode means the angle around which the vehicle rotates about its longitudinal axis.
Rollover protection control system	Means the stability control of brakes for rollover protection.
Roll rate	Means the change of angle per unit time at which the vehicle rotates about its longitudinal axis.
Supplemental restraint system	Means a passive safety system as declared by the vehicle manufacturer, supplementing the restraint system as defined by UN Regulation No 16, with components such as airbags or seatbelt pre- tensioners.
Safety belt status	Means the feedback from the safety system that the vehicles safety belt is fastened or not fastened.
Safety belt status	Safety belt status means the angle of the steering shaft connected to the driver control.
Safety belt status	Safety belt status means the activation of a system, as defined by the manufacturer.
Parking brake system	Means the parking braking system as regulated by UN Regulation No 13.
Time zero	Is the time reference for the EDR data timestamps of an event.
Tyre pressure monitoring system status	Means the operating status of the tyre pressure monitoring system.
Trigger threshold	Means the appropriate parameter has met the conditions for recording an EDR event.
Trigger activated	Indicates which trigger was activated to cause the recording of the event.
Stability Control System Status - Fully Operational	Indicates whether Stability Control is fully operational or whether its functionality is reduced by a permanent or temporary (e.g. low voltage) defect, by intended action (e.g. disabled by a switch or during special diagnostic procedures), not configured or not yet fully initialized (e.g. missing initialization or configuration message).
Vehicle master control switch	Means the device by which the vehicles on-board electronics system is brought, from being switched off, as in the case where a vehicle is parked without the driver being present, to normal operation mode.
Vehicle master control switch	Vehicle master control switch means the longitudinal speed of the vehicle that is calculated or estimated from the Vehicle Speed Sensor (VSS).

TERM	DEFINITION
Vehicle type with regard to its Event Data Recorder	Means vehicles which do not differ significantly in such essential aspects as: a) The manufacturers trade name or mark. b) Vehicle features which significantly influence the performance of the EDR; Addition of new trigger(s), new data (elements), or modification in their format, shall not be considered as significantly influencing the performance of EDR. c) The main characteristics and design of the EDR.
Yaw control system	Means the stability control of wheel brakes for yaw control.
Corrective Steering Function (CSF) status	Means the operating status of the Corrective Steering Function as defined in UN Regulation No 79.
Emergency Steering Function (ESF) status	Means the operating status of the Emergency Steering Function as defined in UN Regulation No 79.
Automatically commanded steering function (ACSF) status	Means the operating status of the Automatically Commanded Steering Function as defined in UN Regulation No 79, and of the categories as defined therein.
Accident Emergency Call System Status	Means the status of a system that is activated either automatically via in-vehicle sensors or manually, which carries, by means of public mobile wireless communications networks, a set of crash-related data and establishes an emergency audio channel between the occupants of the vehicle and an answering point. Faulted status would mean when the system detects it cannot make a call.

Reference: UN Regulation No 169 – Uniform Provisions Concerning the Approval of Event Data Recorders (EDR) for Heavy-Duty Vehicles. E/ECE/TRANS/505/Rev.3/Add.168, Link. Legally binding text is: ECE/TRANS/WP.29/2023/134/Rev.1. [In force: 19 June 2024].

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7. APPENDIX 2: AGE DISTRIBUTION OF CRASH-INVOLVED VEHICLES (NSW)

TABLE 7.1 NUMBER OF VEHICLES (TRAFFIC UNITS) INVOLVED IN POLICE REPORTED CRASHES, NSW 2019-2022

PARAMETER	YEAR OF CRASH				
	2019	2020	2021	2022	TOTAL
CRASHES					
Number of crashes	**20,355**	**18,764**	**17,413**	**18,243**	**74,775**
Fatal	329	264	260	273	1,126
Serious (admitted to hospital)	4,126	3,925	3,251	3,610	14,912
Moderate (treated in Emergency Department only)	5,273	5,293	5,159	4,913	20,638
FSI (killed, treated in hospital)	*9,728*	*9,482*	*8,670*	*8,796*	*36,676*
Minor / other injury	4,196	3,407	2,964	3,080	13,647
Non-casualty (towaway)	6,431	5,875	5,779	6,338	24,423
Uncategorised Injury	-	-	-	29	29
VEHICLE TYPE					
Passenger vehicle					
Car / car derivative	26,419	23,539	21,674	22,575	94,207
Heavy duty vehicle	6,537	6,124	6,171	6,772	25,604
Bus	226	177	159	190	752
Light truck	5,017	4,786	4,721	5,223	19,747
Heavy rigid truck	742	653	718	691	2,804
Articulated truck	552	508	573	668	2,301
Other Traffic Unit					
Pedal cycle	775	854	733	627	2,989
Pedestrian	1,259	996	935	1,051	4,241
Motorcycle	2,379	2,143	2,025	2,009	8,556
Non-motorised vehicle	55	78	83	77	293
Other motor vehicle	718	570	510	606	2,404
Other or unknown	47	73	102	68	290
Total	38,189	34,377	32,233	33,785	138,584

TABLE 7.2 AGE OF PASSENGER VEHICLES (AND DERIVATIVES INCLUDING SPORTS UTILITY VEHICLES [SUV]) INVOLVED IN POLICE REPORTED FATALITY – SERIOUS INJURY (HOSPITALISATION) CRASHES, NSW 2022

VEHICLE AGE	YEAR OF MANUFACTURE	NUMBER OF VEHICLES	PERCENT OF VEHICLES	% CUMULATIVE
0	2022	161	1.7%	1.7%
1	2021	377	3.9%	5.6%
2	2020	345	3.6%	9.2%
3	2019	409	4.3%	13.5%
4	2018	467	4.9%	18.3%
5	2017	539	5.6%	24.0%
6	2016	537	5.6%	29.6%
7	2015	551	5.7%	35.3%
8	2014	498	5.2%	40.5%
9	2013	515	5.4%	45.9%
10	2012	496	5.2%	51.0%
11	2011	445	4.6%	55.7%
12	2010	458	4.8%	60.5%
13	2009	378	3.9%	64.4%
14	2008	428	4.5%	68.9%
15	2007	447	4.7%	73.5%
16	2006	431	4.5%	78.0%
17	2005	404	4.2%	82.2%
18	2004	359	3.7%	86.0%
19	2003	310	3.2%	89.2%
20	2002	203	2.1%	91.3%
21	2001	157	1.6%	93.0%
22	**2000**	**160**	**1.7%**	**94.6%**
23	1999	122	1.3%	95.9%
24	1998	101	1.1%	96.9%
25	1997	61	0.6%	97.6%
26	1996	39	0.4%	98.0%
27	1995	36	0.4%	98.4%
28	1994	32	0.3%	98.7%
29	1993	18	0.2%	98.9%
30	1992	20	0.2%	99.1%
31	1991	13	0.1%	99.2%
32	1990	20	0.2%	99.4%
33	1989	6	0.1%	99.5%

34	1988	2	0.0%	99.5%
35	1987	2	0.0%	99.5%
36	1986	3	0.0%	99.6%
37	1985	3	0.0%	99.6%
38	1983	3	0.0%	99.6%
38	1984	2	0.0%	99.7%
39	1982	2	0.0%	99.7%
40	1981	2	0.0%	99.7%
>=41 years	Pre-1981	29	0.3%	100%
	Total	9,722	100%	

TABLE 7.3 AGE OF BUS VEHICLES INVOLVED IN POLICE REPORTED FATALITY – SERIOUS INJURY (HOSPITALISATION) CRASHES, NSW 2022

VEHICLE AGE	YEAR OF MANUFACTURE	NUMBER OF VEHICLES	PERCENT OF VEHICLES	% CUMULATIVE
0	2022	1	1.1%	1.1%
1	2021	1	1.1%	2.2%
2	2020	5	5.4%	7.6%
3	2019	3	3.3%	10.9%
4	2018	3	3.3%	14.1%
5	2017	8	8.7%	22.8%
6	2016	4	4.3%	27.2%
7	2015	1	1.1%	28.3%
8	2014	10	10.9%	39.1%
9	2013	3	3.3%	42.4%
10	2012	3	3.3%	45.7%
11	2011	6	6.5%	52.2%
12	2010	11	12.0%	64.1%
13	2009	4	4.3%	68.5%
14	2008	5	5.4%	73.9%
15	2007	7	7.6%	81.5%
16	2006	4	4.3%	85.9%
17	2005	2	2.2%	88.0%
18	2004	2	2.2%	90.2%
19	2003	0	0.0%	90.2%
20	2002	2	2.2%	92.4%
21	2001	0	0.0%	92.4%
22	2000	1	1.1%	93.5%
23	1999	1	1.1%	94.6%
24	1998	1	1.1%	95.7%
25	1997	1	1.1%	96.7%
26	1996	0	0.0%	96.7%
27	1995	0	0.0%	96.7%
28	1994	0	0.0%	96.7%
29	1993	0	0.0%	96.7%
30	1992	0	0.0%	96.7%
31	1991	0	0.0%	96.7%
32	1990	0	0.0%	96.7%
33	1989	0	0.0%	96.7%
34	1988	1	1.1%	97.8%

35	1987	0	0.0%	97.8%
36	1986	1	1.1%	98.9%
37	1985	0	0.0%	98.9%
38	1983	0	0.0%	98.9%
38	1984	0	0.0%	98.9%
39	1982	0	0.0%	98.9%
40	1981	1	1.1%	100%
>=41 years	Pre-1981	92	100%	

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TABLE 7.4 AGE OF LIGHT TRUCKS INVOLVED IN POLICE REPORTED FATALITY – SERIOUS INJURY (HOSPITALISATION) CRASHES, NSW 2022

VEHICLE AGE	YEAR OF MANUFACTURE	NUMBER OF VEHICLES	PERCENT OF VEHICLES	% CUMULATIVE
0	2022	76	3.2%	3.2%
1	2021	158	6.6%	9.8%
2	2020	129	5.4%	15.2%
3	2019	137	5.8%	21.0%
4	2018	168	7.1%	28.0%
5	2017	149	6.3%	34.3%
6	2016	135	5.7%	40.0%
7	2015	124	5.2%	45.2%
8	2014	128	5.4%	50.5%
9	2013	128	5.4%	55.9%
10	2012	113	4.7%	60.7%
11	2011	93	3.9%	64.6%
12	2010	98	4.1%	68.7%
13	2009	88	3.7%	72.4%
14	2008	103	4.3%	76.7%
15	2007	79	3.3%	80.0%
16	2006	80	3.4%	83.4%
17	2005	64	2.7%	86.1%
18	2004	41	1.7%	87.8%
19	2003	53	2.2%	90.0%
20	2002	37	1.6%	91.6%
21	2001	19	0.8%	92.4%
22	2000	22	0.9%	93.3%
23	1999	27	1.1%	94.4%
24	1998	25	1.0%	95.5%
25	1997	16	0.7%	96.1%
26	1996	13	0.5%	96.7%
27	1995	8	0.3%	97.0%
28	1994	10	0.4%	97.4%
29	1993	5	0.2%	97.6%
30	1992	10	0.4%	98.1%
31	1991	4	0.2%	98.2%
32	1990	6	0.3%	98.5%
33	1989	7	0.3%	98.8%
34	1988	6	0.3%	99.0%

35	1987	1	0.0%	99.1%
36	1986	2	0.1%	99.2%
37	1985	2	0.1%	99.2%
38	1983	1	0.0%	99.3%
38	1984	2	0.1%	99.4%
39	1982	3	0.1%	99.5%
40	1981	1	0.0%	99.5%
>=41 years	Pre-1981	1	0.0%	100%
	Total	2,372	100%	

TABLE 7.5 AGE OF HEAVY RIGID TRUCKS INVOLVED IN POLICE REPORTED FATALITY – SERIOUS INJURY (HOSPITALISATION) CRASHES, NSW 2022

VEHICLE AGE	YEAR OF MANUFACTURE	NUMBER OF VEHICLES	PERCENT OF VEHICLES	% CUMULATIVE
0	2022	4	1.2%	1.2%
1	2021	18	5.5%	6.7%
2	2020	8	2.5%	9.2%
3	2019	19	5.8%	15.0%
4	2018	27	8.3%	23.3%
5	2017	22	6.7%	30.1%
6	2016	17	5.2%	35.3%
7	2015	18	5.5%	40.8%
8	2014	16	4.9%	45.7%
9	2013	12	3.7%	49.4%
10	2012	18	5.5%	54.9%
11	2011	9	2.8%	57.7%
12	2010	18	5.5%	63.2%
13	2009	13	4.0%	67.2%
14	2008	12	3.7%	70.9%
15	2007	19	5.8%	76.7%
16	2006	11	3.4%	80.1%
17	2005	7	2.1%	82.2%
18	2004	12	3.7%	85.9%
19	2003	7	2.1%	88.0%
20	2002	7	2.1%	90.2%
21	2001	4	1.2%	91.4%
22	2000	6	1.8%	93.3%
23	1999	5	1.5%	94.8%
24	1998	7	2.1%	96.9%
25	1997	3	0.9%	97.9%
26	1996	0	0.0%	97.9%
27	1995	1	0.3%	98.2%
28	1994	1	0.3%	98.5%
29	1993	1	0.3%	98.8%
30	1992	0	0.0%	98.8%
31	1991	0	0.0%	98.8%
32	1990	0	0.0%	98.8%
33	1989	1	0.3%	99.1%
34	1988	0	0.0%	99.1%

35	1987	0	0.0%	99.1%
36	1986	0	0.0%	99.1%
37	1985	0	0.0%	99.1%
38	1983	1	0.3%	99.4%
38	1984	1	0.3%	99.7%
39	1982	0	0.0%	99.7%
40	1981	1	0.3%	100%
>=41 years	Pre-1981	326	100%	
	Total			

TABLE 7.6 AGE OF ARTICULATED TRUCKS INVOLVED IN POLICE REPORTED FATALITY – SERIOUS INJURY (HOSPITALISATION) CRASHES, NSW 2022

VEHICLE AGE	YEAR OF MANUFACTURE	NUMBER OF VEHICLES	PERCENT OF VEHICLES	% CUMULATIVE
0	2022	6	2.2%	2.2%
1	2021	21	7.6%	9.7%
2	2020	15	5.4%	15.1%
3	2019	26	9.4%	24.5%
4	2018	23	8.3%	32.7%
5	2017	21	7.6%	40.3%
6	2016	10	3.6%	43.9%
7	2015	14	5.0%	48.9%
8	2014	14	5.0%	54.0%
9	2013	20	7.2%	61.2%
10	2012	15	5.4%	66.5%
11	2011	5	1.8%	68.3%
12	2010	8	2.9%	71.2%
13	2009	7	2.5%	73.7%
14	2008	5	1.8%	75.5%
15	2007	17	6.1%	81.7%
16	2006	8	2.9%	84.5%
17	2005	9	3.2%	87.8%
18	2004	8	2.9%	90.6%
19	2003	4	1.4%	92.1%
20	2002	4	1.4%	93.5%
21	2001	3	1.1%	94.6%
22	2000	2	0.7%	95.3%
23	1999	1	0.4%	95.7%
24	1998	2	0.7%	96.4%
25	1997	2	0.7%	97.1%
26	1996	0	0.0%	97.1%
27	1995	0	0.0%	97.1%
28	1994	1	0.4%	97.5%
29	1993	0	0.0%	97.5%
30	1992	0	0.0%	97.5%
31	1991	0	0.0%	97.5%
32	1990	1	0.4%	97.8%
33	1989	1	0.4%	98.2%
34	1988	3	1.1%	99.3%

35	1987	0	0.0%	99.3%
36	1986	0	0.0%	99.3%
37	1985	0	0.0%	99.3%
38	1983	0	0.0%	99.3%
38	1984	0	0.0%	99.3%
39	1982	1	0.4%	99.6%
40	1981	1	0.4%	100%
>=41 years	Pre-1981	278	100%	
	Total	556	2.2%	2.2%

TABLE 7.7 AGE OF PASSENGER VEHICLES (AND DERIVATIVES INCLUDING SUV) INVOLVED IN POLICE REPORTED CRASHES, NSW 2019-2022

VEHICLE AGE (YEAR)	FATALITY-SERIOUS INJURY (FSI)			ALL SEVERITIES		
	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT
0†	643	1.6%	1.6%	1,581	1.7%	1.7%
1	1,794	4.4%	6.0%	4,220	4.5%	6.2%
2	1,866	4.6%	10.5%	4,406	4.7%	11.0%
3	2,039	5.0%	15.5%	4,841	5.2%	16.2%
4	2,141	5.2%	20.8%	5,012	5.4%	21.6%
5	2,266	5.6%	26.3%	5,164	5.6%	27.1%
6	2,261	5.5%	31.9%	5,233	5.6%	32.8%
7	2,153	5.3%	37.1%	5,119	5.5%	38.3%
8	2,054	5.0%	42.2%	4,835	5.2%	43.5%
9	2,108	5.2%	47.3%	4,815	5.2%	48.7%
10	1,951	4.8%	52.1%	4,553	4.9%	53.6%
11	1,955	4.8%	56.9%	4,475	4.8%	58.4%
12	1,937	4.7%	61.7%	4,522	4.9%	63.3%
13	1,899	4.7%	66.3%	4,349	4.7%	67.9%
14	1,987	4.9%	71.2%	4,434	4.8%	72.7%
15	1,929	4.7%	75.9%	4,194	4.5%	77.2%
16	1,794	4.4%	80.3%	3,952	4.3%	81.5%
17	1,633	4.0%	84.3%	3,516	3.8%	85.3%
18	1,372	3.4%	87.7%	2,965	3.2%	88.5%
19	1,085	2.7%	90.3%	2,467	2.7%	91.1%
20	892	2.2%	92.5%	1,958	2.1%	93.2%
21	709	1.7%	94.2%	1,508	1.6%	94.8%
22	**587**	**1.4%**	**95.7%**	**1,176**	**1.3%**	**96.1%**
23	408	1.0%	96.7%	831	0.9%	97.0%
24	295	0.7%	97.4%	612	0.7%	97.7%
25	220	0.5%	97.9%	471	0.5%	98.2%
26	164	0.4%	98.3%	338	0.4%	98.5%
27	140	0.3%	98.7%	265	0.3%	98.8%
28	100	0.2%	98.9%	197	0.2%	99.0%
29	71	0.2%	99.1%	159	0.2%	99.2%
30+	365	0.9%	100%	747	0.8%	100%
Total	**40818**	**100**		**92,915**	**100%**	

† Year 0 is a vehicle in its first year of life

TABLE 7.8 AGE OF BUSES INVOLVED IN POLICE REPORTED CRASHES, NSW 2019-2022

VEHICLE AGE (YEAR)	FATALITY-SERIOUS INJURY (FSI)			ALL SEVERITIES		
	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT
0†	3	0.8%	0.8%	5	0.7%	0.7%
1	16	4.5%	5.4%	21	3.1%	3.9%
2	22	6.2%	11.6%	32	4.8%	8.6%
3	18	5.1%	16.7%	31	4.6%	13.2%
4	10	2.8%	19.5%	23	3.4%	16.6%
5	24	6.8%	26.3%	42	6.2%	22.9%
6	15	4.2%	30.5%	29	4.3%	27.2%
7	15	4.2%	34.7%	26	3.9%	31.1%
8	23	6.5%	41.2%	40	5.9%	37.0%
9	21	5.9%	47.2%	37	5.5%	42.5%
10	22	6.2%	53.4%	50	7.4%	49.9%
11	20	5.6%	59.0%	43	6.4%	56.3%
12	25	7.1%	66.1%	39	5.8%	62.1%
13	14	4.0%	70.1%	36	5.3%	67.5%
14	15	4.2%	74.3%	28	4.2%	71.6%
15	12	3.4%	77.7%	23	3.4%	75.0%
16	8	2.3%	79.9%	13	1.9%	77.0%
17	7	2.0%	81.9%	11	1.6%	78.6%
18	10	2.8%	84.7%	17	2.5%	81.1%
19	5	1.4%	86.2%	12	1.8%	82.9%
20	8	2.3%	88.4%	17	2.5%	85.4%
21	9	2.5%	91.0%	19	2.8%	88.3%
22	8	2.3%	93.2%	13	1.9%	90.2%
23	6	1.7%	94.9%	15	2.2%	92.4%
24	1	0.3%	95.2%	9	1.3%	93.8%
25	2	0.6%	95.8%	4	0.6%	94.4%
26	0	0.0%	95.8%	3	0.4%	94.8%
27	1	0.3%	96.0%	2	0.3%	95.1%
28	3	0.8%	96.9%	5	0.7%	95.8%
29	0	0.0%	96.9%	2	0.3%	96.1%
30+	11	3.3%	100%	26	3.9%	100%
Total	**354**	**100%**		**673**	**100%**	

† Year 0 is a vehicle in its first year of life

TABLE 7.9 AGE OF LIGHT TRUCKS INVOLVED IN POLICE REPORTED CRASHES, NSW 2019-2022

VEHICLE AGE (YEAR)	FATALITY-SERIOUS INJURY (FSI)			ALL SEVERITIES		
	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT
0†	216	2.3%	2.3%	444	2.3%	2.3%
1	646	7.0%	9.3%	1,395	7.2%	9.4%
2	626	6.8%	16.1%	1,365	7.0%	16.5%
3	625	6.8%	22.8%	1,397	7.2%	23.6%
4	624	6.7%	29.6%	1,339	6.9%	30.5%
5	534	5.8%	35.3%	1,195	6.1%	36.6%
6	554	6.0%	41.3%	1,151	5.9%	42.5%
7	506	5.5%	46.8%	1,104	5.7%	48.2%
8	493	5.3%	52.1%	1,019	5.2%	53.4%
9	472	5.1%	57.2%	1,015	5.2%	58.7%
10	428	4.6%	61.8%	876	4.5%	63.2%
11	437	4.7%	66.5%	862	4.4%	67.6%
12	397	4.3%	70.8%	831	4.3%	71.9%
13	360	3.9%	74.7%	804	4.1%	76.0%
14	335	3.6%	78.3%	685	3.5%	79.5%
15	301	3.3%	81.6%	609	3.1%	82.6%
16	275	3.0%	84.6%	554	2.8%	85.5%
17	192	2.1%	86.6%	426	2.2%	87.7%
18	172	1.9%	88.5%	350	1.8%	89.5%
19	158	1.7%	90.2%	312	1.6%	91.1%
20	149	1.6%	91.8%	295	1.5%	92.6%
21	112	1.2%	93.0%	237	1.2%	93.8%
22	110	1.2%	94.2%	231	1.2%	95.0%
23	105	1.1%	95.3%	174	0.9%	95.9%
24	80	0.9%	96.2%	143	0.7%	96.6%
25	68	0.7%	96.9%	125	0.6%	97.2%
26	48	0.5%	97.5%	87	0.4%	97.7%
27	34	0.4%	97.8%	71	0.4%	98.1%
28	46	0.5%	98.3%	77	0.4%	98.4%
29	29	0.3%	98.6%	59	0.3%	98.8%
30+	127	1.1%	100%	243	1.2%	100%
Total	**9,259**	**100%**		**19,475**	**100%**	

† Year 0 is a vehicle in its first year of life

TABLE 7.10 AGE OF HEAVY RIGID TRUCKS INVOLVED IN POLICE REPORTED CRASHES, NSW 2019-2022

VEHICLE AGE (YEAR)	FATALITY-SERIOUS INJURY (FSI)			ALL SEVERITIES		
	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT
0†	14	1.1%	1.1%	35	1.3%	1.3%
1	63	5.0%	6.1%	151	5.6%	6.9%
2	70	5.5%	11.6%	152	5.6%	12.5%
3	83	6.6%	18.2%	185	6.8%	19.3%
4	86	6.8%	25.0%	184	6.8%	26.1%
5	78	6.2%	31.2%	155	5.7%	31.8%
6	44	3.5%	34.7%	111	4.1%	35.9%
7	59	4.7%	39.4%	122	4.5%	40.4%
8	46	3.6%	43.0%	102	3.8%	44.2%
9	57	4.5%	47.5%	130	4.8%	48.9%
10	70	5.5%	53.1%	137	5.1%	54.0%
11	58	4.6%	57.7%	126	4.6%	58.6%
12	66	5.2%	62.9%	131	4.8%	63.5%
13	57	4.5%	67.4%	119	4.4%	67.9%
14	63	5.0%	72.4%	143	5.3%	73.1%
15	53	4.2%	76.6%	115	4.2%	77.4%
16	55	4.4%	81.0%	104	3.8%	81.2%
17	42	3.3%	84.3%	75	2.8%	84.0%
18	28	2.2%	86.5%	70	2.6%	86.6%
19	29	2.3%	88.8%	68	2.5%	89.1%
20	25	2.0%	90.8%	44	1.6%	90.7%
21	20	1.6%	92.4%	41	1.5%	92.2%
22	18	1.4%	93.8%	34	1.3%	93.5%
23	13	1.0%	94.8%	33	1.2%	94.7%
24	12	1.0%	95.8%	30	1.1%	95.8%
25	9	0.7%	96.5%	20	0.7%	96.5%
26	10	0.8%	97.3%	13	0.5%	97.0%
27	2	0.2%	97.5%	8	0.3%	97.3%
28	5	0.4%	97.9%	6	0.2%	97.5%
29	5	0.4%	98.3%	13	0.5%	98.0%
30+	22	2.0%	100%	54	2.0%	100%
Total	**1,262**	**100%**		**2,711**	**100%**	

† Year 0 is a vehicle in its first year of life

TABLE 7.11 AGE OF ARTICULATED TRUCKS INVOLVED IN POLICE REPORTED CRASHES, 2019-2022

VEHICLE AGE (YEAR)	FATALITY-SERIOUS INJURY (FSI)			ALL SEVERITIES		
	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT	NUMBER OF VEHICLES	PERCENT OF VEHICLES	CUMULATIVE PERCENT
0†	29	2.9%	2.9%	57	2.8%	2.8%
1	83	8.4%	11.4%	176	8.6%	11.4%
2	94	9.5%	20.9%	202	9.9%	21.3%
3	77	7.8%	28.7%	156	7.6%	28.9%
4	73	7.4%	36.1%	155	7.6%	36.5%
5	65	6.6%	42.7%	136	6.7%	43.2%
6	59	6.0%	48.7%	129	6.3%	49.5%
7	56	5.7%	54.4%	107	5.2%	54.7%
8	48	4.9%	59.2%	94	4.6%	59.3%
9	53	5.4%	64.6%	117	5.7%	65.0%
10	32	3.2%	67.8%	67	3.3%	68.3%
11	31	3.1%	71.0%	67	3.3%	71.6%
12	38	3.9%	74.8%	72	3.5%	75.1%
13	32	3.2%	78.1%	65	3.2%	78.3%
14	37	3.8%	81.8%	73	3.6%	81.8%
15	38	3.9%	85.7%	71	3.5%	85.3%
16	31	3.1%	88.8%	69	3.4%	88.7%
17	29	2.9%	91.8%	56	2.7%	91.4%
18	17	1.7%	93.5%	33	1.6%	93.1%
19	12	1.2%	94.7%	25	1.2%	94.3%
20	5	0.5%	95.2%	17	0.8%	95.1%
21	11	1.1%	96.3%	17	0.8%	95.9%
22	5	0.5%	96.9%	16	0.8%	96.7%
23	2	0.2%	97.1%	8	0.4%	97.1%
24	2	0.2%	97.3%	11	0.5%	97.7%
25	3	0.3%	97.6%	4	0.2%	97.8%
26	3	0.3%	97.9%	7	0.3%	98.2%
27	2	0.2%	98.1%	4	0.2%	98.4%
28	2	0.2%	98.3%	5	0.2%	98.6%
29	3	0.3%	98.6%	5	0.2%	98.9%
30+	14	1.4%	100%	23	1.1%	100.0%
Total	**986**	**100%**		**2,044**	**100%**	

† Year 0 is a vehicle in its first year of life

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