

The AAA Approach to Crash Investigation Reform – The Perspective from Road Policing Practitioners.

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Key Findings

- The crash investigating reporting process is convoluted in its complexity and in need of a complete overhaul to ensure it is *fit for purpose*;
- Crash data analysis must be based on accurate, timely and meaningful data entry elements;
- The AAA approach combines the core components of traditional 3 E's and the contemporary Safe Systems Approach
- The AAA approach to crash investigation provides a simple and practical approach to data and analysis as a foundation to road safety reform;
- Requiring the investigator to focus on contributory factors and preventative actions has the potential to change the paradigm of crash investigation from reactive to pre-emptive reform.

Abstract

Professional road crash investigation, complemented by intelligent analysis and dynamic actions provide the foundation for road safety reform. However, to date, the real potential resulting from police investigative findings have not been fully realised due to the lack of streamlined connectivity from the crash scene to the reform process. Such deficiencies include inadequate investigations, inadequate data management, convoluted processes, system delays, inadequate analysis and limited immediate and mid-term actions which should be generated following thorough and efficient investigations. A review of processes across high, medium and low-income countries has identified a more effective approach to achieving results in road safety reform across all road safety disciplines. The simple AAA framework to 'Acquire, Analyse and Action' is presented as a contemporary model to ensure an evidence-based foundation drives road safety reform to identify root cause analysis locally, nationally and globally. This provides structure, discipline and purpose as well as technical skill and competence to achieve practical recommendations as preventative measures for crash reduction. A multi-disciplined expert review team to validate/assess/modify these recommendations in serious crashes ensures constructive countermeasures are prioritised and actioned. This facilitates a paradigm shift in thinking and analysis to achieve a continuous improvement process designed to reduce road trauma and save lives.

Keywords

Crash investigation; Road Policing; AAA; Acquire, Analyse, Action; Road Safety Reform;

Acronyms

AAA – Acquire, Analyse, Action

EDR – Event Data Recorder

ERT – Expert Review Team

LMICs – Low and middle-income countries

SSA – Safe Systems Approach

UK – United Kingdom

USA – United States of America

WHO – World Health Organisation

3 E's – Enforcement, Education and Engineering

24/7 – Operational response: 24 hours a day, 7 days a week

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Introduction

Road crashes, injuries and deaths are a serious cost and humanitarian concern internationally. They result in tragedy for many families, pain and suffering for many individuals and are a huge resource cost to police and other emergency services in attending motor vehicle collisions, extracting the dead and injured and follow-up aftercare, reports, and investigation.

Achieving road trauma reduction is a complex challenge involving the interrelationship between road users, vehicles, road infrastructure and emergency rescue. Road crash investigation is a vital means of identifying causality and initiating action for reform in all these disciplines, ultimately to provide safer travel and reduce casualties. The United Kingdom (UK) police policy decrees that road deaths be approached with the same investigative standard of thoroughness, impartiality and effectiveness as unlawful killings until the contrary is proven (ACPO 2001).

Crash investigation has traditionally been vested with traffic police having a 24/7 emergency response capability. Outcomes generally focus on identifying offences or offenders as a basis for criminal and civil litigation. The broader and more purposeful approach is to maximise the value of crash investigations and proactively impact reform across all road safety disciplines. However, this reform is inhibited by the inadequacies of the investigative process, the complexity of data capture and extensive delays in data analysis. Key stakeholders in the use of this data must appreciate that the value of detailed investigations and analysis will enhance the integrity of countermeasures and reform.

Technical advice, training manuals and crash reporting practices ignore a prime remedial rationale for investigations as considered by the International Civil Aviation Organisation in aircraft crash investigations i.e. to determine *why the accident happened and how similar events might be avoided in the future* (<https://www.icao.int/Pages/default.aspx>). Here, the immediate actions address system faults and provide continuous training for the pilot(s). Similarly, engaging the road crash investigator in this process ensures a commitment to identify *real causes* with ownership of potential solutions through active involvement in road safety reform.

The paper emphasises the need for a *mindset* change for investigators to *prevention focused* analysis and a *mindset* systems' refresh to focus on preventative strategies rather than merely collection and analysis. Improving these foundational aspects will drive more purposeful and timely *action reform*.

A simple, practical, and targeted model is presented to achieve this action-based reform. Through effective training in this disciplined approach, the skills of police

crash investigators will be highly valued and meaningful in achieving productive outcomes in road safety interventions globally.

Methodology

This paper examines the process of road crash investigation, data recording and analysis to determine its current contributory effectiveness in road safety reform. The discussion follows to identify a more practical crash investigation perspective to achieve more focused and timely outcomes across all road safety sectors.

The perspective is presented from two road safety and road policing specialists, practically and professionally experienced in over 25 low and middle-income countries (LMICs) over 20 years, as well as veteran policing experience in Australia and other high-income countries. This perspective is enhanced through direct crash investigation experience and providing training and guidelines as crash investigation specialists internationally. Deeper insights are obtained working with crash investigation practitioners, understanding the environment, living within the communities and specifically as participant observers and assessors of police investigations and operations.

The limitations of this conceptual approach recognise organisational reluctance to readily change the status quo, particularly if it involves additional responsibility, training, strategic planning, and decision making for themselves and their operatives. This particularly applies to the recommended expert review process involving leadership to identify crash causes and implement remedial action. Additionally, the prevention foci is a constructive add-on to current investigations. This concept appreciates the potential that police and the legal systems may view identified *system* weaknesses as a mitigation against legal culpability. These aspects should not prevent implementation and be addressed through *evaluation and continuous improvement*.

To achieve positive outcomes, organisations must firstly acknowledge inefficiencies in their current policies and practices and be prepared to train operatives to achieve road safety outcomes. The process will dramatically streamline the feedback loop from crash to reform to ultimately save lives.

Background

The original conceptual framework of countermeasures for road trauma was consolidated by Julien H Harvey in 1923 with the 3 E's triangle being Engineering, Education, and Enforcement (Damon 1958). These three elements have maintained currency in strategic and modelling crash risk interventions. Systems' analysis of road trauma progressively gained impetus following the Haddon

Matrix general injury prevention model (Haddon 1972) with variations of the construct of the 3 E's being adopted (Donaldson, 2002), (Derakhshani, 2019). More recently, the Safe Systems Approach (SSA) has become the primary model for reducing traffic crash fatalities and serious injuries (OECD/ITF 2008).

The SSA seeks to understand crashes and risk and apply system reforms through safer roads and roadsides, safer vehicles, safer road users and safer travel speeds and create a road transport system in which human mistakes do not result in serious injury or fatality (Jurewicz, 2010, Steinmetz, 2015, Doecke, 2018). While engineering, education and enforcement are key contributors to this approach, albeit under a broader framework, the focus is to acknowledge human errors as failings and address systemic system solutions.

Over decades, most fatality crashes have been attributed to human factors frequently referred to as errors and ranging from 71% to +/- 90% (Treat 1980, McDonald 1985, PIARC 2003, Stander 2005, Shinar 2007, Shuey 2013). This operator failure (the human factor) remains the single greatest obstacle to safety in vehicular travel (Mawson 2014). These deliberate or careless actions include high-risk road user behaviours such as dangerous driving, speeding, drink and drug driving, fatigue, and distracted driver behaviours. Failure to comply with the basic safety precautions such as occupant restraints and motorcycle helmets also contribute as human failings.

James Reason described errors as skills-based, rule-based, and knowledge-based, acknowledging these may frequently occur without consequences. However, he describes the *trajectory of accident opportunity penetrating the defensive systems* as the collectively failures of latent errors aligning with system inadequacies (Reason 1990). This is a window of opportunity, colloquially referenced in later reports as the *swiss cheese* effect when the holes align in crash potential or accident sequence (Reason 2000, Peltomaa 2012). These errors may also be considered as levels of driver performance not being adequately skilled as a novice or importantly not having safety ingrained as attitude, behaviour, and culture (Shuey 2013).

The complexity of these errors with their differing interpretations in road safety provides a challenge to eliminate the collective failures of individuals or strive towards error-tolerant design infrastructure to be forgiving of human errors as applied in the SSA. However, strategists, reformists and scholars shy away from trying to eliminate the human errors and draw a distinction between errors and pre-meditated deliberate civil disobedience to the rule of law creating a high-risk situation. Whether deliberate or careless, the consequences bear the same impact. It is therefore critical to accurately and timely identify the real crash causes and minimise speculation so that effective remedies can be implemented.

The foundation for this is the integrity of the crash investigation and the timeliness from the crash to any action, reform or countermeasure.

Data collection

Accurate data collection and efficient analysis provides the basis of well-founded road safety strategies. These enable the underlying causes of crashes to be identified and road safety exposures treated (Shuey 2013). The quality of this data is fundamental for the accuracy of crash analyses, and consequently the design of effective countermeasures as well as an intelligent crash reporting system (Imprialou and Quddus 2019). Further, crash data provides basic information for effective highway safety efforts at any level of government, however, the lack of uniformity among countries and among different jurisdictions in the same country is prevalent (Montella, 2019).

Universally, police reports provide the primary data source for analysis and commentary by road safety management, researchers, and reformists. These reports provide a broader database than those in-depth multi-discipline and forensic specialists assessing a small proportion of crashes meeting a set criteria (Larson, 2004). It is therefore incumbent to ensure this process adds value to road safety reform. However, over time, the data capture requirement has gradually increased in complexity to satisfy the statistical agency *needs* while omitting critical issues required of a reform agenda. Convolved collision reporting procedures range from detailed hand-written reports and manual completion of proforma templates, to direct entry into sophisticated data systems.

Mandated data requirements ensure officers consider and assess numerous categories, classifications, data elements and values, tick boxes and alternatives varying from up to 200 data entry considerations in Australia, UK and United States of America (USA) to 14 pages of information in the Kingdom of Saudi Arabia.

These requirements include detailed measurements, photographs, a crash narrative, offender interviews, victim, and witness statements, and will complement the data requirements as evidential briefs for penalty assessment, administration, legal liability, or financial compensation. Recently, *dynamic data elements* have been introduced to record any automated system(s) present (NHTSA 2017). Police data is therefore useful for general analysis, but often lacks the fidelity to understand crashes through the identification of *contributing factors* (Doecke 2020).

Accurate data collection globally is hindered by the lack of universal adoption of the WHO standard fatality definition of death within 30 days of a crash and the variation of interpretation of serious injuries. Further, under-reporting of both fatalities and serious injuries, especially of vulnerable road users, combined with extensive delays and/or the unavailability of serious injury data and causation restricts real-time or effective reform in the 3E's or SSA.

The under-reporting of crash numbers deprives road safety reformists with the opportunity to fully appraise the real magnitude of countermeasures and seek commensurate funding to address the gravity of the problem. The International Transport Forum on the road safety performance of 42 member and observer countries claims that police data significantly understates the number and seriousness of crash injuries (ITF Road Safety Annual Report 2020).

Effective reform requires timely, accurate and meaningful data at the point of entry.

The government is very keen on amassing statistics – they collect them, add them, raise them to the n^{th} power, take the cubed root and prepare wonderful diagrams. But what you must never forget is that every one of those figures comes in the first instance from the village watchman, who just puts down what he damn pleases.
(Sir Joseph Stamp, 1929)

While this historic quotation draws attention to data quality, a critical issue is the lack of timely analysis to action strategic reform. Normal *acceptable* lapses are twelve months to consolidate actions from the fatality database to more than two years for the broader serious injury database.

Data analysis

From initial information, data is coded, computerised, collated and analysed. Validation criteria and quality controls apply in some jurisdictions for vehicle and personal identification as well as linking to hospital and insurance surveillance. Following this array of different processes, analysts and researchers extract data for the purpose of identifying countermeasures and strategic reform.

Identifying, collating and consolidating crash causes is traditionally a longitudinal process undertaken through analysis of a substantial database of fatal crashes and trends. Serious injury data bases, *if maintained*, are rarely considered in this analysis. Australian states separately collect and analyse statistics complemented by data, recording and analysis by the Office of Road Safety in its National Road Safety Data Hub.

Further, crash causes can be a matter of interpretation. The clinical approach examines events, behaviours and conditions, while the epidemiological/statistical approach examines factors and variables divergent from the normal driving population. The emerging naturalistic approach examines all behaviours, events and conditions available in an objective data format (Shinar 2007). *Whatever approach is used to examine causes, it is substantially reliant on the biases and inefficiencies of the foundational data collection.*

The quality of the crash investigation

The quality of crash investigation varies globally from poorly trained traffic police undertaking basic investigation to identify fault or compensation liability to highly qualified forensic analysts. Multi-fatality investigations may be undertaken by multi-disciplined police crash investigation specialists on 24/7 call-out such as Victoria and New South Wales police. Some jurisdictions operate with a formal multi-discipline response capability for multi-fatality or set criteria call out of a multi-discipline response team usually with hi-tech and forensic capability. However, while fatality and serious injury rates remain high, the ability of these hi-tech investigative bodies to attend all serious crashes is not possible. Further, notwithstanding, the in-depth analysis of these bodies, the immediacy of reform is rarely actioned.

Concerns have been raised about the quality and reliability of *analysed* police data which is simplified and standardised without any meaningful appreciation of behavioural issues leading to the crashes (Larson 2004). In Queensland, the reliance on police data for the counting of road crash injuries can be problematic when compared to hospital data where it was found around two thirds not linking to any record of police data (Watson 2015). Similar results of under-reporting were found in New Zealand with less than two thirds of all hospitalised road crash casualties recorded in police data (Alsop 2001). An accurate representation of the road crash injury problem is essential for prioritising funding and resources as well as targeting and evaluating road safety interventions. (Watson 2015).

Crash statistics are often less useful in determining the actual cause of the crash as the data collected often only reflects the information obtained at the crash scene and not the events that preceded the crash (Oskarbski, 2020). What must be acknowledged is that in most cases, more than one cause contributes to a crash. These issues need to be searched for, scrutinised and analysed at the time of the crash. Contributory factors are considered as those, if removed, the crash would not have occurred (Shinar 2007). Statements espoused 60 years ago hold credence today.

No official traffic safety program can be fully effective without an adequate accident reporting and records system. Only with good accident facts, properly analyzed and intelligently used, can enforcement be properly directed, educational effort be effectively aimed, and traffic and highway engineering be scientifically applied (Damon 1958).

Current research identifies subjective reasoning attributed to misrepresenting causes and the complexity of crash reports inviting commentary under *injudicious actions*. Some categories such as *driver inexperience* or *aggressive driving* are ineffective in driving road safety reform unless some action follows. The trend in the UK

is for contributory factors to be classified into coherent categories to maximise statistical clustering and minimise the risk of misinterpretation by police (Rolison 2020).

Crash investigation therefore, without initial robust root-cause analysis has the potential to bias the outcome and dilute the intervention. Positive and negative biases have been observed in some countries with police identifying infrastructure as a cause when they are responsible for speed management and conversely engineers blaming the lack of speed enforcement as the cause. While traditional roles are important, all disciplines should have a primary focus on identifying the *real causes* i.e. root cause analysis and contributory factors.

While police investigations are principally targeted towards prosecuting an offender, the research identifies the need for quality-based data collection processes to ensure the accurate identification of real causes.

Observational perspectives

Observational perspectives in both high-income and LMICs support the research commentary. Specifically:

- Initial investigations are deficient in identifying the real causes of crashes
- The priority of investigations is to determine fault
- Investigators require a higher level of skill and equipment
- The data collection process is complex, cumbersome and time consuming
- Traffic police often do not have the time and in many cases, the training needed to gather and record the required data
- Under-reporting, omissions and inaccuracies lead to misleading analysis
- The delays in reporting, collating and analysing data does not support timely reform
- Contributory factors need to be an automatic component of any recommendations
- Data sharing is deficient however, should be an essential outcome of any analysis.

Discussion – considering alternate approaches

Sweden and The Netherlands within their Vision Zero strategies, focus on prevention providing the foundation for the SSA in management and sustainable safety. Sweden's vision is to identify elements of a crash which determine fatality or survivability under OLA (**O**bjective data, **L**ist of solutions, and **A**ddressed action plans). High crash risks identified include run-off road crashes, head-on, intersectional side-impact, and vehicle-pedestrian crashes (OECD/ITF 2008).

In the UK, the lead police investigator has responsibility to debrief investigations to identify lessons learned, which contribute to preventative measures and referrals to partner agencies. Investigators should ensure that longer-term prevention, intelligence and enforcement opportunities are identified and shared with local neighbourhood policing teams. In Australia, road defects and infrastructure issues are likewise required to be notified to partner agencies. While road safety audits may be undertaken following some high-profile crashes, it is not the norm.

Independent crash investigation and reconstruction professionals may be engaged in court trials to support a prosecution or defend an accused, however, *rarely involved in preventative measures*. In LMICs the investigations are generally less rigorous for routine fatalities (such as pedestrian, motorcycle or 1-4 fatalities) although many countries have multi-discipline teams responding to high profile and multi-fatality crashes. In the USA, the National Highway Traffic Safety Administration (NHTSA) has implemented the Fatal Analysis Reporting System (FARS) which allows users to query the database of fatalities and extract information relating to the specifics of crashes and the cause of those crashes.

Similarly, the EU has, through the European Transport Safety Council (ERSC), developed a centralised repository for road crash trauma data including an Annual Road Safety Performance Index which details levels of road trauma on a country basis, however, it does not provide the detailed level of functional data investigation that the NHTSA provides. Australia has a National Transport Safety Bureau however, under the umbrella legislation of the Transport Safety Investigation Act 2003, their primary focus is on air, rail and marine transportation safety. Expanding the resource or functional roles of these bodies does not present as a viable alternative improve the road crash investigation process.

An avenue for reform is the coronial process, particularly in the UK and Australia, where it provides a critical role in exploring and identifying crash causes, for serial, clusters, systemic or multi-fatality crashes. Court hearings occur months or years after events and often recommendations must be extracted from lengthy findings. Inquests into *single vehicle run off road crashes*, while more frequently occurring on rural roads, do not receive the same rigorous investigative or *cluster* considerations and may only result in a *Chamber Finding*. Clarity of recommendations and preventative actions need a formalised process for road safety reform.

It is also acknowledged that Parliamentary Committees are established to canvass specific safety issues such as motorcycle safety, speed, pedestrians, drink driving, driver distractions or general increases in road fatalities. These committees accept submissions from interested parties and provide recommendations for legislative change or government initiatives. The time lapse from any

issue being first raised to countermeasures or solution is frequently years.

The serious system delays in reform internationally is demonstrated in identifying and actioning education, legislation, enforcement, and remedial countermeasures for driver distractions in mobile phone use and drug driving, the emergence of which have now spanned two decades. A further clear example is the failure to acknowledge the importance of EDRs in assisting the identification of crash causes, which, while being stressed by specialist investigators, is not pursued at a strategic level. The critical issue is that the EDR on airbag deployment, captures time-series data in the last five seconds of speed, braking, acceleration, deceleration and evasive actions, as well as some post crash information. This data provides a better understanding of crash causes and safer vehicle designs.

USA has legislated endorsement under the Federal code for investigator access to the EDR data elements (NHTSA, DOT Part 365), the United Nations has a proposal under consideration (UN Reg No 160.00) and the ETSC is advising on refining specifications, now mandated in the EU from 2022. Endeavours to streamline data retrieval and maximise benefits, although having been discussed at the Australian and New Zealand Police Commissioners' Forum 18, 10-11 October 2019 has not been pursued for national reform of the Australian Design Rules.

It is noteworthy that much of the information obtained from these multi-disciplined teams, independent reviews and coronial inquests do not find their way into the official data systems for ultimate analysis. Some recommendations may be independently actioned. It is also relevant that while many jurisdictions have computerised data entry and contributory factor databases, the immediacy of data reform is not driven through crash investigation findings. *Critically, there are limited formalised preventative measures encouraged to be recommended by investigators.*

A catalyst for change – the need for a paradigm shift in thinking and processing

Continuing with the same processes year on year will inevitably achieve the same results. The research integrated with the observational perspectives highlights the need for accurate data to ensure productive countermeasures, enforcement and reform activities. It follows that if the foundational data is inaccurate, omitted, inefficient, or delayed, then any analysis or data mining is likely to have misleading or inaccurate outcomes. These inefficiencies directly impact the timeliness and framing of strategies.

This leads to a need for a *mindset change* for the investigator to be prevention focused in crash analysis and a similar *mindset system refresh* so that the system is directed towards reform. Currently, there is a vast amount of suppressed evidence which can be harnessed to crash prevention strategies to saving lives.

The weakness in the current approach is the lack of a legitimate *voice* of the crash investigator. Considering the time, effort and expertise in attending crashes, taking photographs, measurements, checking environmental issues and interviewing witnesses, this presents as a untapped resource to address prevention as a key outcome. We trust the investigator to prepare a *prima facie* case for prosecution in all countries, why not trust those same skills (upgraded if necessary), to present a *prima facie* case for reform? This opinion/recommendation can then be presented to a multi-discipline *Expert Review Team* for comprehensive analysis.

By broadening the analysis to a holistic review *at the time of the investigation*, more meaningful and preventive measures can be identified. The voice of the investigator is important to assist this process.

The following model is a simple process which recognises and addresses the need for efficiency and effectiveness to be the basis of road safety reform. It is presented as the catalyst for change to instigate a paradigm shift in thinking and action and as a first step in converting road tragedies into prevention and reform.

The AAA Conceptual Approach

The AAA approach is a road safety perspective that recognises that road safety outcomes can only be achieved if road safety programs are based on relevant, accurate, timely and accessible data. While not discipline specific, it's three key components recognise the value of efficient and effective data management in a practical application to achieve results. The process is applied directly to the crash investigation commencing at the scene and equally applicable in the strategic approach involving:



Acquire – Gather all relevant information, understand the real situation, understand the real causes of crashes, improve the collecting, recording and storage of basic crash data, improve the crash investigators' skills and identify, evaluate and expand data sources.

Analyse - Understand the patterns, trends, emerging issues and the management of that information. Identify the risk factors and understand the relationship between cause and outcome.

Action - Apply strategically-driven, evidence-based (evidence of effectiveness) and outcome-focused road safety interventions and then assess the effectiveness of those interventions.

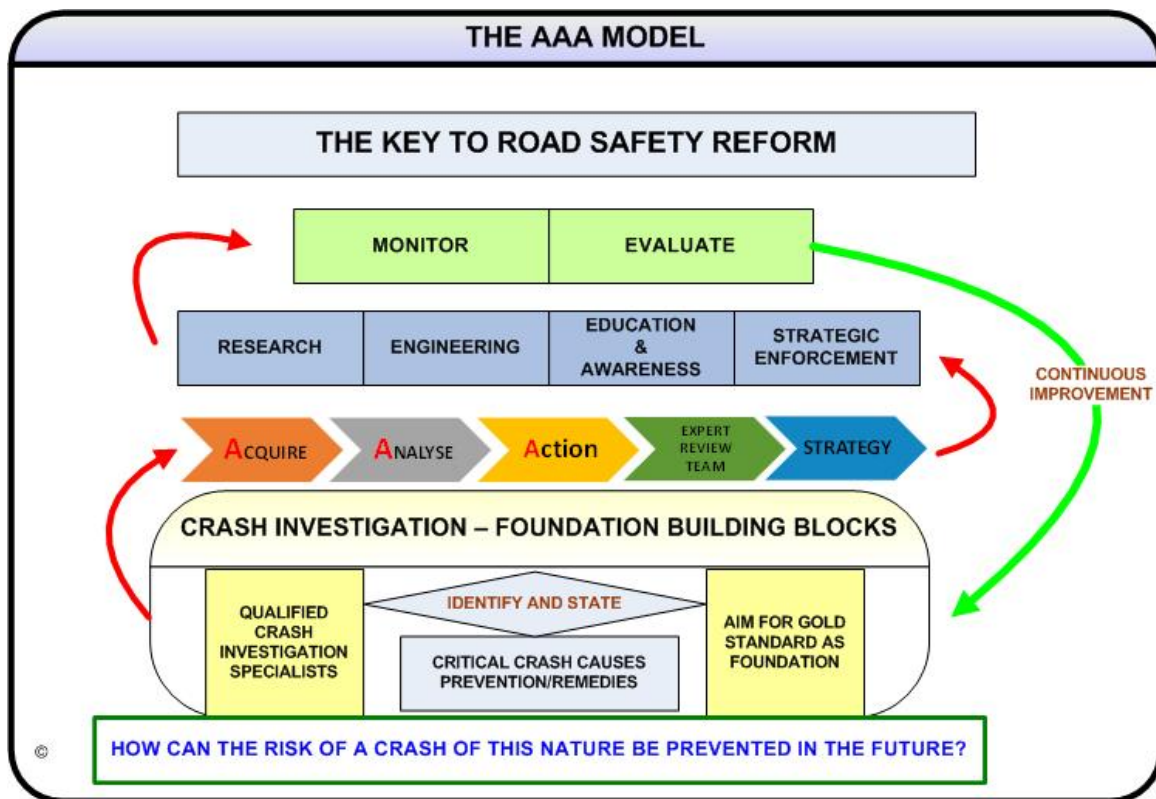


Figure 1. AAA Model of Crash Investigation

The foundation of the model is the thorough, professional and methodical investigation of crashes, undertaken by qualified crash investigation specialists, which result in meaningful and achievable *recommendations for the prevention of future crashes*.

The AAA model depicted in Figure 1, involves a process of continuous improvement that monitors and evaluates the overall process so as to ensure it remains relevant, timely and responsive.

This model is focussed on addressing the weaknesses identified in the current processes to develop road safety strategic, operational and tactical planning. It is designed to identify the real causes of road trauma and achieve real road safety outcomes. The model combines both historical and contemporary thinking in strategic road safety policy and action plan development by incorporating the Safe Systems and the traditional 3 E's approach.

It is noted that SSA in its current implementation is not achieving the significant outcomes anticipated especially in LMIC as the reform emphasis is on unaffordable infrastructure and technology with minimal attention to road user behavioural reform. The short to medium term answer is to make the road users safer through strategic road safety planning that involves implementation of effective enforcement and education/awareness programs.

By compelling the investigator to advise on prevention or remedial recommendations *in every crash*, it engenders a mindset change, develops credence in the investigator's opinion and voice and directly attributes to the reform agenda.

NB: As standard procedure in the AAA process, the chief police investigator is required to proceed with due process for any prosecutable actions or compensatory findings identified in the investigation and under the law of the country. Additionally, as part of the road safety reform process, there is a requirement to identify and state the primary, secondary and tertiary contributory factors and make a recommendation as to ***how can the risk of fatalities or serious injuries from a crash of this nature be prevented in the future***. This is a critical opinion based on the evidence adduced from the investigation and required to instigate the reform process which is then contemporaneously addressed by an expert review team (ERT).

The Expert Review Team

To strengthen the recommendation of the initial crash investigator(s), the systems approach needs the power and authority to initiate action reform. It is appreciated that the investigating officer, however skilled, does not have the authority, wisdom and multi-disciplined experience to address all issues. The investigator's opinion/recommendation is the starting point from which to build

evidence-based reform. This also ensures contributory ownership of the reform agenda for all involved.

The ERT should be convened within two weeks to review every fatal crash as a multi-discipline approach. This dynamic review is intended to raise the criticality of any fatality and the requirement for an action-oriented response, without usurping the role of any subsequent judicial process. The team should comprise a representative of the road safety council as chair with the following members:

- The investigating police expert
- A senior traffic police officer from the province/district
- A representative from the Road Traffic Authority with engineering experience
- A local government representative
- Community leader
- Other experts to be coopted as required depending upon the nature of the crash
 - Those with mechanical expertise
 - Medical or health service experts
 - Any party with a vested interest in the outcome (not victims)

In a number of countries, additional Forensic Crash Investigation is undertaken by independent and qualified investigative institutes to review the findings and recommendations of police crash investigators. Examples of these are:

- Pakistan - Automotive and Crashworthiness Research facility.
- Thailand - Traffic Accident Research Centre (TARC) for validation of police crash investigations.
- Malaysia - Malaysian Institute for Road Safety Research (MIROS) in a similar capacity.

The benefit of a multi-discipline analytical approach is that the collective skills and knowledge will identify real causes and preventative actions as a primary and unified focus. This then must be addressed practically according to legislation, resourcing and skills available.

This approach is action-focussed and partnership-based directed towards a reform agenda. It provides a structure to achieve a mindset change for the investigator and a system change directed towards the identification of real causes. The analyses focus for both the investigator and the ERT to prevent future crashes will require parallel training and guidelines.

This process operates as a formalised and action-oriented debriefing. It is complementary to strategic analysis of a broader jurisdictional database of fatalities, injuries and crashes over extended periods to address trends, clusters, blackspots, black lengths, and repetitive human behaviour failings. However, it is enacted as an immediate response

to a tragedy and as a direct contribution to the reform agenda.

This focus presented is a mindset change to enable a voice for the investigator and the ERT in the immediacy of road safety reform. The cybernetics of continuous improvement within the model through evaluation, acknowledges there still may be inefficiencies which can be addressed through experience, skill and additional training. The ERT process is a model which should be implemented immediately in both high-income and LMICs.

Results

The research and practical experience from the practitioners have identified critical deficiencies in the current crash investigation processes with limited immediate value available for road safety reform. The research has not endeavoured to resolve all deficiencies raised. However, the AAA model introduces the first step in a mindset change for the investigator and a system mindset change for the overall process. Checks and balances are incorporated into the model to ensure continuous improvement. The following findings are presented:

- The crash investigating and reporting process is convoluted in its complexity and in need of a complete overhaul to ensure it is *fit for purpose*;
- Crash data analysis must be based on accurate, timely and meaningful data entry elements;
- The AAA approach to crash investigation provides a simple and practical approach to data and analysis as a foundation to road safety reform;
- The AAA approach combines the core components of both the traditional 3 E's and the contemporary SSA;
- Requiring the investigator to focus on contributory factors and preventative actions has the potential to change the paradigm of crash investigation from reactive to pre-emptive reform.

Conclusion

This paper has examined the processes of crash investigation from an operational and practical perspective, as well as drawing upon research, to identify critical deficiencies in the investigation, recording and analysis of road trauma. A simple AAA model is presented which enhances the role and *voice* of the crash investigator, supported by an Expert Review Team to identify and drive road safety reform. *This approach is designed to clearly identify three contributory factors as priority and then make a determination as to how the risk of this type of crash can be prevented in the future.* The benefit of this paradigm shift in thinking and action is in the immediate identification of reform actions and interventions for short-term gains reinforced through tactical, operational, and strategic planning for long-term gains. The ultimate goal is saving lives locally, nationally and internationally.

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