Sustainable Mobility through Safer Roads: Translating Road Safety Strategy into Local Context in Western Australia

Shariful Malik, Mohammad Shahidul Hasan Swapan * and Shahed Khan

School of Design and the Built Environment, Curtin University, Bentley, WA 6102, Australia; shariful.malik@postgrad.curtin.edu.au (S.M.); s.khan@curtin.edu.au (S.K.)
* Correspondence: m.swapan@curtin.edu.au; Tel.: +61-08-92661999

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Abstract: Road safety is an ongoing challenge to sustainable mobility and transportation. The target set by the Sustainable Development Goals (SDGs) suggests reframing the issue with a broader outlook and pragmatic system. Unlike previous road safety strategies and models that favour engineering solutions and legal instruments, there is an increasing need to consider local context and complexities. While such principles have been increasingly featured in higher-level policy frameworks in national or state-level strategies (e.g., Safe System or Vision Zero approach), an effort to translate them into implementable actions for local development areas is absent. To address this gap, this study aims to develop a conceptual framework to examine the nature and extent to which statewide principles are translated into local government policies. We outline a 4C Framework (consisting of clarity, capability, changing context, and community engagement) to evaluate local policy integration in Perth, Western Australia. A five-point indicative scale is applied to evaluate the selected policy instruments against this framework. The results show that only a little over a quarter (27%) demonstrated a highly satisfactory performance in capturing higher-level policy objectives. The low-scoring councils failed to demonstrate the ability to consider future changes and inclusive road design. Councils along the periphery having new residential development showed comparatively greater success in translating overarching strategies. Regional cooperation has been very effective in enabling local agencies to adopt a more sustainable pathway to road safety measures. The criteria proposed within the framework will play a pivotal role in effective policy integration and to achieve more context-sensitive outcomes that are beyond the scope of modern road safety strategies.

Keywords: road safety; sustainable mobility; Vision Zero; 4C Framework; policy integration; local government; Western Australia

1. Background

Road-traffic-related deaths and safety issues are ongoing concerns in metropolitan transport planning. The Sustainable Development Goals (SDG Goal 11.2) specifically recognise safer roads as one of the key elements of sustainable mobility and transportation [1]. The World Health Organisation (WHO) estimated around 1.35 million annual fatalities across the globe [2]. The SDGs’ target of a 50% reduction in the death toll through the United Nations’ Decade of Action for Road Safety (2011–2020) still remains a significant but distant milestone, despite the fact that it is already 2020 [3,4].

Road safety research has relied significantly on knowledge from practice for a critical insight to the theories, models, and strategies for risk reduction. Over the decades, the overall approach to road safety strategies has been a simplistic and reductionist one that followed an objective-oriented assessment. A multi-causal perspective, taking into consideration a series of factors contributing...
to the occurrence of road crashes, is rarely addressed. Wegman [3] pointed to the overwhelming emphasis placed on accident data (also referred to as a data-driven approach) and engineering solutions. Hagenzieker, Commandeur [5] defined this paradigm as being guided by three E’s: Engineering, Education, and Enforcement. Such a paradigm is based on a common misperception about road safety that associates it exclusively with speeding and risk-taking behaviour on the roads. While road crashes are subjected to legal investigation to determine enforcement measures and penalise behavioural misconduct, they by no means explain the full extent of the problem [6].

During the past few decades, there has been a policy shift towards promoting a system approach to address road safety measures by taking into account human factors, environment, and causative agents as defined by the Haddon matrix [7,8]. In the early 1990s, the Dutch ‘Safe System’ approach pioneered such paradigm shifts where both road designers and road users have shared roles to play [9]. While the earlier road safety management approaches were biased towards users’ performance on road, focusing on who or what caused the crash, the Safe System approach looks beyond that and treats crashes as a system failure. It emphasises that “the current road system is inherently unsafe and that road users are frequently placed in circumstances where errors are to be expected” [6]. Between 1992 and 2002, Sweden and Australia adopted a system-wide approach with an increasing reliance on behavioural and psychological theories of road safety management. However, there is a lack of evidence on transforming such strategies into implementable actions.

The Safe System approach is typically defined by its four pillars, including safer roads, safer vehicles, safer speeds, and safer road users. The ‘safe’ road users approach adopts a behavioural perspective focusing on the human ability to use the road in sustainable ways. There are, however, many ramifications with extant legislative and regulatory measures to control human errors in the system. In 2011, the United Nations put road safety on the global agenda, calling for an international coordination among countries to promote sustainable mobility through adopting the Safe System approach [10]. Meanwhile, in 1997, Sweden introduced a ‘Vision Zero’ approach that elevated the responsibility of road designers to consider a long-term vision with enhanced “philosophical and ethical value of human life” [9]. Several experts claim, however, that despite an increasing concern with human behaviour and psychological factors, recent approaches in many developed countries continue to remain focused on infrastructure-based measures, referring to national implementation strategies [10–14].

2. Australian Experience

Australian public policy on road safety response in the early stage of adoption of the Safe System approach mirrored the global trend, with a restricted and limited outlook targeting the behavioural change of drivers through instrumental measures. Even the National Road Safety Strategy (2001–2010) failed to offer a sustainable framework of road safety to deal with broader societal issues like perceptions of safety, comfort of driving, shared responsibility, and the psychological ramifications of road infrastructure [15]. The outcome was not remarkable, with only 3.3% reduction in annual road fatalities noted after the adoption of this approach, a far cry from a 30% reduction in road fatalities set by the current National Road Safety Strategy (2011–2020) by 2020. Inspired by Swedish Vision Zero and Dutch ‘sustainable safety approach’, the Australian Safe System approach upholds four key principles: recognition of human errors; absorption of kinetic energy by improved vehicles; shared responsibility to prevent crashes; and strengthened entire road systems to protect road users [16]. Referring to the insignificant success of the Australian approach, Hughes, Anund [17] argued that the core idea of the systems approach and its underlying elements is yet to be adapted to the local context. Picton and Bueren [18] further added that “the vision of zero is admirable, moral and endorsed by the community”—however, it is unclear how this can be achieved [18].

Hughes, Anund [17] maintained that, because much of the discussion around improving road safety strategies revolves around the overarching goals of higher-level policy making, ambiguity and confusion remain unresolved in translating them into implementable actions. Although Hagenzieker,
Commandeur [5] claimed road safety research “is now moving into an increasingly scientific and cross-disciplinary phase”, many critics point to the need for wider socio-cultural shifts and community engagement in designing effective road safety measures [3,15,19]. Many road safety scholars maintained that implementation strategies would be critical to success, especially in the face of the changing socioeconomic context and development trends in metropolitan areas [17,20]. Wegman [3] further claimed that while “Safe System principles are rather universal … local conditions and circumstances will dictate how these principles can be translated into local action”. However, there is a dearth of research on implementation frameworks to evaluate these emerging principles associated with the sustainability turn in road safety strategies [15]. Moreover, despite the uncertain territory of future road safety, current efforts remain directed towards a wider policy level, paying little attention to how local context and conditions should inform policy implementation and define community engagement protocol. As a result, the vast majority of road safety strategic actions still rely on road engineering and driver education and enforcement. This is an area of increasing concern for many local government areas in Australian cities experiencing significant changes in their physical form (i.e., built environment) and witnessing socioeconomic transformations.

To address this gap in road safety research and policy integration in the local context, this study aims to develop a conceptual framework to examine the nature and extent to which statewide principles and policies are translated into local government jurisdictions of the Perth Metropolitan Area (PMR) in Western Australia (WA). In this regard, we focused on recent transformational actions of road safety principles by assessing the extent of policy adoption and the incorporation of community sensitivities. This was done by evaluating local policies and strategic documents of local governments. Based on an in-depth policy review of 30 local governments in the PMR, the paper seeks to highlight the status of road safety governance and the pathway to a more sustainable mobility framework.

3. A Conceptual Framework to Examine Local Policy Integration

This section sets out to critically discuss the theoretical underpinnings of higher-level road safety policies. The discussions will aid in outlining a comprehensive and pragmatic framework enabling policy evaluations on road safety measures. Evaluation of planning policies and strategic documents provides critical information on their operational efficiency and quality of performance in relation to the broader goals and targets [21]. The method further enables us to comprehend philosophical shifts in the development of road safety strategies and policy frameworks, moving from a quantitative outlook to a more inclusive and contextualised approach [22]. Michie, Van Stralen [23] questioned how well policy intervention frameworks of behaviour change improve the design and implementation of evidence-based practice. Their systematic literature review scrutinised 19 such frameworks for comprehensiveness, coherence, and links to an overarching model of behaviour and found that only a few frameworks met the criteria of coherence or linkage to a model of behaviour. With reference to interventions for behavioural change, Fylan [24] pointed to two main challenges: a lack of details of interventions provided and an absence of shared language to describe the interventions, making it difficult to compare the effectiveness of different models. Meanwhile, Greene [25] suggested the application of a combination of four spectrums in evaluating outcomes: interpretivism that recognises localisation of broader goals and understanding diversity; post-positivism that promotes efficiency and effectiveness in the implementation process; pragmatism that considers uncertainty, practicality, social, and cultural change; and, finally, normative science that promotes stakeholder participation in the design process.

This philosophical approach informs the formulation of the following four key research questions for this study that seek to assess the extent of the uptake of critical aspects of the state-level road safety vision at the local government level.

- Clarity of policy alignment—How clearly is the statewide road safety vision translated into local context?
• Capability considerations—How effectively are multifaceted risks resulting from the introduction of shared road users and competing travel demands accounted for?

• Changing contexts—To what extent do local policies and strategies consider uncertainty of the future and recognise land-use changes over time?

• Community engagement—To what extent are local stakeholders engaged in designing road safety measures?

3.1. Clarity of Policy Alignment with State-Level Thinking

Road safety research and practice underwent significant transformation in terms of policy direction since an organised approach started before the 1950s. The initial approach in road safety strategies relied heavily upon engineering solutions. The Risk Homeostasis Theory (1982) [26] suggested the inclusion of precautionary safety measures for vehicles and roads to reduce the risks [27]. This theory was criticised for promoting a sense of safety among drivers that, in turn, led to exposure to collision on the roads [19,28]. This prompted consideration of the entire road system, leading to a new paradigm of the road safety regime that looked into critical synergies between physical infrastructure and users’ risk perceptions and behaviour. The behavioural thinking concept attracted several multi-disciplinary fields of knowledge, like health, sociology, and psychology, to contribute to road safety research that took into account human factors and local texture [19]. A more recent shift to ‘sustainable safety’ by the Dutch and the Swedish ‘Vision Zero’ promoted strong ethical values in human life and considered sustainable utilisation of road infrastructure and users. The emerging philosophies enabled the shared responsibilities of motorised and non-motorised users and recognised transformation in the built environment. Several models and operational frameworks have evolved over time, which have incrementally added physical and human factors, such as Haddon’s Matrix [29], on sequencing crash phases; Risk Homeostasis Theory [26], on reducing drivers’ exposure to crashes by adding physical safety measures; Health Beliefs Model [30] that promotes the individual’s perceived knowledge of health benefits and its effect on behaviour; Theory of Planned Behaviour [31], to explain one’s perceived understanding of hazard and socio-psychological factors determining safety behaviour; and Gibbons and Gerrard [32]’s theory of the willingness model, which explains factors affecting safe driving behaviour among young and older age groups [33]. However, Hughes, Anund [34] argued that a comprehensive list of policy tools grounded on emerging theories and practices to guide local road safety management is yet to be developed. Hughes, Anund [17] comprehensive framework, consisting of seven components of road safety management based on system theory and principles, attempted to bridge the limitations of previous models but lacked empirical evidence and guidance for local applications with complex and emerging land use and transportation needs.

A comprehensive translation of statewide road safety at the local government level requires the formulation of implementable actions, context-specific targets, and broad-range projects addressing road safety components, including projects related to research, education, and regulation under a clear funding structure. Hughes, Anund [17] emphasised that specific policy tools, including micro-level strategies and interventions, are required in the goal reduction process. They stated that the guiding principles highlighted by the policies and strategic documents must demonstrate “moral value” leading to the practice (p. 37). It is contended thus that the outcomes of the emerging philosophies enshrined in the state-level policies should be demonstrated in their conceptualisation and translation in a local context to inform road safety practice. This should be observable as the policies move beyond adopting a data-driven approach towards a “context-sensitive mode of planning” [35] and become focused on users’ attitudes towards infrastructure, interventions, and technology [36].

3.2. Capability Considerations of Various Users and Nonlinear Risk Topography

A disaggregated view of the road safety paradigm suggests differentiation and clustering of issues in terms of understanding the risks and behaviours of various groups of users, such as different age groups, parents and children, local residents, etc. [8,37]. May et al. (2008) suggested that a segmentation
strategy of road users and an understanding of their competing travel and safety demands are critical to sustainable transport system design. Such a strategy encompasses demographic or socioeconomic groups (e.g., groups based on age, gender, and length of stay in the area) as well as user types (e.g., pedestrians, cyclists, or drivers). A segmentation approach enables targeted interventions in place of blanket solutions that do not consider context and consumer demands.

A mix of land use and shared road users introduces further complexity in road safety management in local government areas. Mixed-use development generates a variety of road users, including pedestrians, cyclists, motorists, and school-going children, within a non-commuting context. Road safety measures should ensure a healthy and equal road-sharing environment. While, as Christmas, Helman [38] maintained, “infrastructure has a role to play in improving the culture of road sharing”, it is equally important to explore “the degree of safety they [users] are perceived to offer both to themselves and to other road users” [39]. Road safety strategies often do not include such an important factor, which is particularly critical for local government road safety measures.

Road safety research is often carried out in generalised terms rather than being focused on geographic, cultural, and social contexts [37]. Increasingly, however, cognitive and emotional perceptions of risk are recognised by the road safety researchers and practitioners. Elvik [40], for example, referred to the theory of planned behaviour as outlined by Ajzen [31] to establish the connection between sociocultural aspects and attitudes towards road safety issues. Elvik [40] emphasised that social norms, culture, interpersonal belief, and subjective rationality define the social context that influences attitudes and motivations towards safety issues such as those caused by speeding and drink-driving.

3.3. Changing Contexts Reflecting Future Trends and Uncertainty

The future is unpredictable, uncertain, and becoming more complex. Road safety measures developed based on historical data and stable conditions are unlikely to solve these growing complexities [41]. Therefore, a robust and comprehensive framework that can adjust with changing circumstances is critical [17]. Road safety is likely to be impacted by the changes in the context derived from demographic change, socioeconomic transformation, and technological innovation [17]. Several studies predicted changes in safety perceptions over the coming decades with the advent of new technologies and climate change, such as technological advancements in information and communication technology (ICT), automated vehicles (AVs), and measures to reduce CO₂ emissions and mitigate other climate change impacts that could enhance vulnerability in road use [42,43]. Introduction of the Autonomous Emergency Braking (AEB) system in vehicles is expected to reduce driving errors significantly. As a result, traditional road safety measures will need to be adjusted with technological innovations [44]. Soteropoulos, Berger [45] further suggested that the introduction of AVs will “have impacts on accessibility and transport demand … on travel behaviour, such as the type of activities, number of journeys, or the choice of transport mode”. A pragmatic road safety framework should consider uncertainty and changes associated with future scenarios [46,47]. Such ramifications can be effective in preparing for major disruptions, e.g., those brought on by technological breakthroughs and lifestyle changes, and, more recently, pandemics.

The rise of the shared riding business model (e.g., Uber, Didi, and Ola) will contribute to changing travel behaviour patterns in the cities, which will definitely affect the nature of safety on roads [48]. Travel patterns and behaviours are also influenced by the changing land-use patterns. An increase in mixed-use development encourages a greater mix of various road users. With a strong infill-biased urban development strategy and the adoption of liveable neighbourhood design principles, local governments are embracing accelerated growth in Australian suburbs. This is leading to complex road safety issues and challenges to the overarching mitigated approach. Land-use-specific and dynamic design principles considering future growth trends are an integral part of the comprehensive planning.

*There is also an increasing realisation that the road user’s preference and motivation is not static but rather often influenced by lifestyle and technological disruptions, such as smart vehicles [45,49].*
New market demands might significantly dictate the transport preferences (e.g., active transport) in the road safety perception regime [15].

3.4. Community Engagement and Inclusivity in Road Safety Design and Management

Community engagement is seen as a prerequisite of sustainable development [50]. Exploring community perceptions, needs, and aspirations is seen as the first step towards defining appropriate and acceptable planning outcomes. While there is an increasing trend of promoting community engagement by the state agencies in designing road safety strategies, detailed policy directions are often lacking.

Road safety strategies have traditionally focused on incorporating legal mechanisms to implement actions and penalties. The new strategies require the adoption of a more bottom-up approach to shape community behaviour. According to Picton and Bueren [18], “A little over third of the community have no awareness or knowledge of the concept of a Safe System”. As local government agencies prioritise community awareness and participatory planning accompanied by clear budgetary allocations, road safety design professionals can take this opportunity for meaningful outcomes. Pursuing public participation in road safety research and design serves to inform, consult, involve, and collaborate with the community or road users to understand their behavioural reasoning and design preferences [51].

Michie, Van Stralen [23] suggested a three-dimensional system (COM-B system) to enhance community engagement and behavioural change, including: capability, motivation, and opportunity. Capability and motivation refer to an individual’s psychological or emotional judgement and willingness to be involved in decision-making. It also leads to one’s planned behaviour on roads and engagement in community-wide measures [31]. Opportunity, on the other hand, emphasises interventions and factors promoted by external sources such as the local government agencies. It is important to investigate the extent to which local government agencies undertake the promotion of community engagement, i.e., whether they merely offer a lower degree of participation (informing) or higher-level participation in the decision-making processes. Effective community engagement also facilitates the monitoring and collection of feedback on the impacts of policy implementation, which enables relevant agencies to initiate adaptive measures to adjust with changing contexts [52].

4. Study Area Context

The study focuses on local governments in the PMR of WA to examine local policy integration. Road safety has remained one of the alarming concerns in relation to urban and regional roads in WA. The latest state strategy, Towards Zero–Road Safety Strategy 2008–2020, was endorsed by the Western Australian Local Government Association (WALGA) in 2008. The strategic vision adopted the principles of the Safe System approach. WALGA set the Towards Zero vision to “eliminate death and serious injury within the road network by creating a safe system that accommodates human error and the vulnerability of the human body” [53]. To capture the major shift in road safety management in local government, WALGA’s Local Government Safe System Project (LGSSP) (2009) stepped beyond the conventional approach and suggested the shared responsibility of all government and non-government actors in translating the broader principles of the Safe System approach to the local community level. The significant role of local government in promoting “moral and ethical standpoints” to achieve positive outcomes on roads was widely accepted [53]. The strategy aimed at a 40% reduction in the road fatalities by 2020, taking the number of occurrences during 2005–2007 as the baseline [54]. The fatality rate was recorded at 6.3 per 100,000 persons in 2019, which was higher than the target set by the Towards Zero vision, as well as the national average of 4.7 per 100,000 persons [55]. The recent crash data released by the Road Safety Commission clearly showed a nonlinear risk topography stemming from various factors involved in crashes on WA roads [56]. Around 45% of metropolitan crashes in 2019 occurred by colliding with nearby walls and trees. The number of fatalities in the last year involved various vulnerable road users: 20% were motorcyclists and 6% pedestrians. The crash data reveals that
58% of all crashes on WA roads in 2019 were related to drivers’ behavioural factors, including speeding, drink-driving, fatigue, and inattention. The male population was over-represented (74%) in crash incidences [56]. This has further necessitated translating the broader vision into implementable actions for the local context. In response, the RoadWise programme of WALGA recently offered support to local government in implementing the Towards Zero vision, particularly in developing policies and campaigns [54].

The PMR consists of 30 local government areas that are grouped into five metro regions by the WA Local Government Association (WALGA) (Figure 1). Local government roads are a critical part of the road safety management, as 84% of the Australian road network lies within local government jurisdiction, where almost half of all road casualties occur [56]. In WA, 88% of all roads are managed by local governments, where 61% of all serious crashes occur. Although most of the local governments in WA have demonstrated a positive attitude towards adopting Safe System principles, several limitations remain, including a lack of clarity and guiding principles in policy integration, competing priorities, and limited funding and other resources. In this regard, WALGA [53] called for more evidence-based road safety strategies to implement on local roads.

Figure 1. Local government councils in the Perth Metropolitan region (PMR) [57,58].

5. Methodology

In this study, we analysed relevant policy documents of 30 local governments in the PMR to examine the adoption of the state government’s road safety vision. The policy documents were collected from the respective jurisdictions’ official websites. The policy assessment method was adopted from previous planning studies that demonstrated the benefits of policy document analysis to understand the trend of local planning practice [59]. Major planning and community planning documents and other relevant policy documents addressing local transport development were reviewed and analysed. A comprehensive set of evaluation criteria based upon the conceptual framework was used to examine the translation of statewide road safety strategies and the extent of their adoption by local governments. The criteria were adopted and modified from Hughes, Anund [17] 7P Systems Framework criteria, which were originally applied in evaluating state-level road safety strategies in Australia and New Zealand. Table 1 lists and summarises the types of policy documents reviewed in this study.
Table 1. Types of policy documents selected for policy analysis.

| Types of Policy/Strategic Document | Narratives |
|-----------------------------------|------------|
| The Strategic Community Plan (SCP) | Key documents representing the long-term (10 years span) strategic vision for future development of the Local Government. They contain strategic guidelines for most of the development sectors, including environment, economics, transport, and community. Such documents often contain indirect policy direction towards local application of road safety measures within a targeted time frame [60,61]. For example, the SCP (2017–2027) of the City of Kwinana outlines the “safe and efficient integrated network of roads, footpaths and cycle routes supported by a good public transport system” and sets clear targets for implementable actions [62]. |
| Integrated Transport Strategy (ITS) and Transport Strategy (TS) | Various forms of strategic documents and study reports dedicated to implementing transport-related programmes/projects at the local level. Adoption of specialised strategic documents on transport demonstrates local governments’ commendable performance, and more direct policy aimed at local application of road safety measures is likely to be featured. Both the ITS and TS provide specific directions in accordance with the SCP. These documents determine the extent of the transport problem and opportunities for improvement integrated with local land use. They often highlight sustainable mobility infrastructure, facilities for shared road users, and areas of conflicts [63]. |
| Regional Cooperation on Road Safety | Local government councils often form coalitions to design and deliver critical services in a regional jurisdiction. The Eastern Metropolitan Regional Council (EMRC) works on behalf of six participating councils in the PMR. The EMRC was established under the Western Australian Local Government Act 1995 to facilitate collaborative initiatives in regional transport, waste management and education, resource recovery, environmental management and regional development [64]. Regional strategic documents outline the shared vision to promote and enforce sustainable goals among participating councils. The Regional Integrated Transport Strategy (2017–2021) of the EMRC serves to “advocate and support the development of a safe, efficient and effective transport system that supports and enhances the region’s economic, social and environmental wellbeing” [65]. Road safety is identified as the top priority in the region and the EMRC’s Regional Road Safety Plan (2020) and Direction Zero 2015–2018 offer clear guidelines on an integrated road safety action plan for the member councils. The regional initiative enables local councils to work harder on implementable actions for road safety on their local roads. |

This paper adopted a document analysis approach, subjecting a range of local government policy documents to a multi-criteria evaluation. It sought to assess the effectiveness of the policies in reflecting the higher-level principles enshrined at the state level. The relative effectiveness of the policies was measured along the four critical dimensions identified in the literature review presented in the earlier sections. The resulting ‘4C Framework’ for policy evaluation measured the following principles: Clarity of policy alignment; Capability considerations of various users; Changing contexts; and Community engagement. Applying the 4C Framework, we thus set out to examine local government policies in terms of their clarity regarding safety, their capability of responding to the competing demands of various road users, their level of consideration of future context, and, finally, their willingness to engage the community in the process.

A five-point indicative scale was applied to evaluate the selected policy instruments against each criterion. While no defined hierarchy was developed to assess local road safety strategies, an indicative scale and narratives commonly available in existing literature and public policy documents were used. The basic scoring scale was thus developed and adapted according to the concepts and indicative search keywords/terms (Table 2). A list of keywords used in this analysis to determine the councils’ performances across 12 criteria of the 4C Framework is presented in Table 3. The evaluation was based primarily on a keyword search for text related to the four criteria in target policy documents and the nature of their treatment or incorporation in those policies.
Table 2. Measuring the incorporation of state-level policy directions.

| Degree of Incorporation of Relevant Keywords/Terms | Score | Indicative Policy Integration Category |
|---------------------------------------------------|-------|----------------------------------------|
| Keywords or criteria discussed, with comprehensive actions to address them identified | 5 (max) | Competent (4–5) |
| Keywords or criteria discussed, with some actions streamlined | 4     | Competent (4–5) |
| Keywords or criteria discussed and/or addressed, but superficially | 3     | Evolving (3–4) |
| Keywords or criteria discussed and/or addressed | 2     | Below margin (1–3) |
| Keywords or criteria not discussed even if mentioned | 1 (min) | Below margin (1–3) |

Adapted from Hughes, Anund [17].

An aggregated score of each council calculated across the 4C Framework was further grouped into three policy integration categories: below margin, evolving, and competent. A score of 1 or 2 was clearly suggestive of an absence of effective incorporation of state-level policy directions. On the scale, a score of 3 represented a minimally adequate level of incorporation. Therefore, a score from 1 to 3 demonstrated a position below the margin. A score from 3 to 4 represented an evolving context where councils had streamlined relevant policies/strategies for implementation but lacked implementable policy tools; above 4 was an indicator of higher competency, showing commendable performance across all 12 criteria. The description of criteria and an explanation of the scoring methods are found in Table 3.
Table 3. 4C Framework to examine the adoption of the statewide road safety vision into the local context.

| Principles | Criteria | Description | Scale and Indicative Criteria |
|------------|----------|-------------|-------------------------------|
| **Purpose** Keywords: Towards zero, Vision Zero, safer roads, safer speeds, safer vehicles, safer users, risk perception, and safety knowledge | Aligned with statewide road safety vision and sustainability principles | Lack of appropriate goals, objectives, targets, and outcomes in relation to state-level strategic documents and approaches | Greater clarity and specifications of goals, objectives, targets, and outcomes in relation to state-level strategic documents and approaches; synergies with higher-level targets broken down into defined factors and groups |
| **Clarity of policy alignment** Keywords: safe strategy, Safe System theory, safe design, integrated transport planning, sustainable transport, sustainable development, sustainable mobility, sustainable urban mobility, sustainable infrastructure | Upholding the core values of recent developments in road safety measures (e.g., Vision Zero) and sustainable development agenda for local context | • Data-driven approach | • Recognition of multiple factors influencing road safety approach |
| **Policy tools** Keywords: policy, standards, governance, research, education, regulation, strategy, law and enforcement, resilient and road safety budget | Road-safety-related programs/projects supported by clear funding structures | • No specific projects outlined | • Broad range of projects are outlined |
| **Segmentation** Keywords: age, ethnicity, disability, gender, pedestrian, cyclist, drivers, and street patterns | Various road users are recognised (e.g., motorist, cyclist, and pedestrian) as well as demographic or socioeconomic groups (e.g., age, gender) in the policy instruments | • Users are treated without any differentiation | Differences in capability of various road users are acknowledged but not reflected in policy measures |
| **Capability considerations** Keywords: mixed vehicle, Vulnerable Road Users (VRU), intersection style (signalised, unsignalised, roundabout), car parks (angle, parallel), appurtenances (roadsides), Local Area Traffic Management (LATM), mobility, risk perceptions, and behaviour | The complexities of a mixed-use development are considered in terms of road sharing and safety perceptions of other users | • Road-sharing infrastructure is absent in road design | Differences in capability and behaviour of road-user types are reflected in road safety measures |

- **Below Margin**
- **Evolving**
- **Competent**
| Principles | Criteria | Description | Scale and Indicative Criteria |
|------------|----------|-------------|------------------------------|
| Capability considerations | Social context | Keywords: cultural, socioeconomic, behaviour, altitude, interpersonal belief, trust, and motivation | A recognition that the motivations and barriers to safe driving are different for individuals [18]; social and physiological backgrounds are highlighted to address users’ safety behaviour | Below Margin | Evolving | Competent |
| Nature of Future | Keywords: Technology (AV, AI, VR, Maas, TaaS), lifestyle, context, disruption, ramification, recession, disaster (natural, human-made), revolution (shift from one to another with time), and resources (materials, products, labour, equipment) | Uncertain future and technological change and climate change impacts are considered | Considered stable and in a certain context | Aware of changing context | Full recognition of ambiguity and uncertainty with greater detail of strategic direction |
| Consideration of changing contexts | Future land-use assessment | Keywords: mix-used development, urban sprawling, liveable neighbourhoods, urban infill, heritage, climate and weather, and environmental impacts | Future land-use change and other developments affecting community travel behaviour and preferences are recognised | Not sensitive to existing and future land use (estimates, forecasts, and models) | Broad range of road safety solutions | Greater detail of forecasts/estimates, models |
| | Consumers’ demands | Keywords: infrastructure (self-explained road), modal choice, user perceptions, alternative fuels, efficiency, and cognitive functioning | Travel behaviour and safety perceptions of road users might change | Consumers’ preferences are ignored | Consumers’ preferences are recognised but rarely reflected in the strategies | Broader description or greater level of detail in changing transport preferences |

| Keywords: cultural, socioeconomic, behaviour, altitude, interpersonal belief, trust, and motivation |
| Relies on strategy and a behavioural model based more on ‘principles of physics and logic than on the cognitive performance of drivers within a social context’ [37] |
| Relies on both quantitative and qualitative models but a lack of focus on social context |
| Relies on both strategy and models stemming from quantitative and technical facts as well as the social context to get insight to the safety issues |

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### Table 3. Cont.

| Principles       | Criteria                                                                 | Description                                                                 |
|------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Co-design        | Keywords: public participation, community consultation, inform, collaborate, involve, engagement, collaborative education, alliance, and coalition | Inclusiveness and the nature of public participation in road safety research and design (inform, consult, involve, collaborate) * | Scale and Indicative Criteria                                                                 |
|                  |                                                                          | Nil or low level of community engagement (informing only) in mediating and designing road safety measures | Below Margin | Evolving | Competent |
|                  |                                                                          | Medium level of participation (e.g., consultation) proposed in project design |                        |          |           |
|                  |                                                                          | Higher level of engagement proposed to collaborate with relevant stakeholders to understand the context and safety perceptions, offering appropriate and alternative solutions |                        |          |           |
| Community engagement | Communication Keywords: users, authority, Main Roads Western Australia (MRWA), Department of Transport (DoT), Public Transport Authority (PTA), Western Australia Planning Commission (WAPC), Western Australia Local Government Authority (WALGA), Road Safety Commission (RSC), Institute of Public Works Engineering Australasia (IPWEA) | Nature of interface between road users and the authority to raise one’s voice on road safety issues | - No or cumbersome channels in exchanging views between actors  
- Lack of transparency and awareness of the process among actors | - Line of communication is identified but with a lack of feedback mechanism  
- Transparency is maintained through general practice | - Greater clarity and opportunities to exchange views and reporting on road safety issues  
- Opportunity to share and adjust strategies for transport-related programmes/projects |
|                  |                                                                          | Medium level of interconnectedness, interactions, dependency, and synergy among actors and system components with less detail |                        |          |           |
|                  |                                                                          | Higher level of interconnectedness, interactions, dependency, and synergy among actors and system components with greater detail |                        |          |           |

* Reflecting on the participation spectrums of the International Association for Public Participation (IAP2), inclusiveness and nature of public participation in road safety research and design refer to informing, consulting, involving, and collaborating with the community/users to understand their behavioural reasoning and design preferences [50].
6. Results

The analysis of the selected policy documents of the city councils in the PMR based on all 12 criteria across four principles revealed an average score of 3.09 (on a scale 1–5), which demonstrated an adoption, just above the minimum acceptable level, of the statewide road safety vision and incorporation of broader considerations. Around 43% of all councils scored below the minimum acceptable level, while another 30% could be classified under the evolving category (scoring between 3 and 4). Only a little over a quarter (27%) demonstrated highly satisfactory performance (scoring above 4) in capturing higher-level policy objectives in their local contexts. The Shire of Peppermint Grove and City of Vincent scored the lowest (1.54), while, on the other hand, the City of Belmont and City of Perth (CBD) yielded the highest average scores (4.63), considering all 12 criteria (Figure 2).

![Average scores of the councils across 12 criteria and positioning within policy integration categories.](image)

**Figure 2.** Average scores of the councils across 12 criteria and positioning within policy integration categories.

There was not much difference observed in overall average scores across all four principles—clarity, capability, change consideration, and commitment to community engagement (Figure 3). In comparative terms, however, capability scored higher (3.18) with a less dispersed variance ($\sigma = 0.99$) than other principles across all local governments. Belmont, Perth, and Bayswater stood out for demonstrating better clarity in terms of translating broader road safety strategies. A high percentage of councils (44%) performed poorly (below the minimum level) due to a lack of clarity in policy documents, while an even higher percentage (47%) of local governments performed just as poorly due to a lack of community engagement in road safety design and management (47%) (Figure 4a).
Across the 12 criteria, over 40% of local governments performed poorly (with marginal scores below the minimum expected) in relation to clarity and community engagement (Figure 4b). Interestingly, in communication and partnership criteria under the community engagement principle, comparatively fewer councils received a competence score. Breaking the general trend, Belmont and Perth came across as high achievers with scores of 5—Belmont in clarity and Perth in its commitment to community engagement.

Further analysis of the 12 factors revealed that local government policies performed relatively better in aspects related to segmentation, social context, and co-design (Figure 4b). Meanwhile, the aspect that came across as the weakest in comparison to others related to the communication channel between the councils and the community. In the evolving category, the representation of the councils was observed to be consistently low (20–30%) across all criteria (Figure 5).
The deficiencies in major policy documents were manifold, including a lack of recognition of road safety provided little clarity on how local safety issues would be dealt with. On the other hand, while South Perth undertook better initiatives towards integrating local transport to make all suburbs accessible, safety principles were left unattended [61]. It was interesting to observe that a few relatively higher density local government areas located in the inner city ring of the PMR (e.g., Nedlands, Claremont, and Cottesloe) seemed to consider the need for infrastructure, shared movement, and considerations of the local context (congestion, parking, and anti-social behaviour). However, their councils’ policies showed a minimal implementation strategy with no funding structure proposed. A recent study in Claremont, meanwhile, revealed decreasing community awareness of road safety due to the lack of an appropriate education programme and priority in budget development [66].

A number of councils appeared as promising (average scores between 3 and 4) in translating the broader vision into their respective jurisdictions. Councils in this category demonstrated a better motivation by delivering streamlined policy documents for overall transport network management and, in some cases, some specifications on road safety issues. At this evolving stage, the councils close to the periphery of the PMR facing new residential development have started to conceptualise the vision of recent road safety approaches, but have yet to come up with comprehensibility and greater details for implementation. The policy documents of Cockburn (scored 3) clearly indicated long-term guidance for transport planning. The council touched most of the criteria outlined in the 4C Framework. The City of Armadale (3.75) outlined best practice road safety strategies and infrastructural requirements to meet the statewide vision. With similar scores, Kwinana highlighted Safe System and Towards Zero visions and aligned with the ‘Guidelines for Preparation of Integrated Transport Plans’ [62,63]. The available documents provided a broad guideline for a safe and efficient integrated network of
roads, footpaths, and cycle routes supported by a good public transport system. Two high achievers in this category, Stirling and Wanneroo (scored 3.25 and 3.46, respectively), demonstrated a higher level of conceptualisation and willingness to apply more specific policy tools to address road safety issues in their jurisdictions. The SCP of Stirling offered a comprehensive outlook on understanding traffic accidents and travel speed. It also considered the future complexity and development trends outlined by the major metropolitan plans (e.g., Perth and Peel @ 3.5 million, Directions 2031, etc.). The policy of Wanneroo captured the concept of safe spaces, centres, and facilities within infrastructure management and designs for community benefit and recreation. Its transport strategy also determined development priority based on future land use and transport demand [67].

The policy analysis identified a number of competent councils that showed higher levels of policy integration in translating statewide vision with reference to ‘considering changing contexts’ and ‘community engagement’. The standout performance of Belmont and Perth city councils can be justified by their strategic location and development priority in the PMR. For example, Perth (4.63) accommodated the CBD and the central transport and pedestrian-friendly shopping hub. The SCP rightly considered land use and infrastructure planning that facilitated a wide range of public and private sector investments. Its ITS suggested significant safety improvements across all modes of transport and committed to the state’s Towards Zero road safety vision. The strategy further aimed to target road safety and future transport behaviour. Similarly, Belmont recently progressed through a large transport infrastructure project and hosted the international airport and intermodal freight terminals [65]. Belmont also appeared as a progressive organisation by taking into consideration future uncertainty (e.g., economic recession and technological changes). Fremantle, another council in this category, proposed the increased priority of sustainability in community perceptions for development interventions. Its ITS proposed road space for cycling that was physically separated from other traffic to ensure safer and shared mobility.

It is evident that councils with regional cooperation in addressing road safety issues had better policy outcomes. The members of the EMRC (Bassendean, Swan, Bayswater, Kalamunda, Mundaring, and Belmont) demonstrated a greater consideration of road safety strategies. Taking road safety as the top priority in the region in the face of increasing population growth and infrastructure development, the EMRC came up with a number of relevant strategies, such as the Regional Road Safety Plan (2020) [53] and Regional Integrated Transport Strategy (2017–2021) [65]. The Road Safety Plan [53] provides

Strategic guidance for the EMRC member Councils’ overarching strategies to support and advocate for the reduction of the number of people killed and seriously injured on roads within the Region in line with the Western Australian State Government’s Towards Zero—Western Australia’s Road Safety Strategy 2008–2020.

The EMRC advocated promotion of pragmatic and comprehensive road safety measures among the member councils that address complex and dynamic land use and behavioural change among vehicle users as well as pedestrians and cyclists. The regional initiatives helped respective local governments to develop policy instruments that cater to local road safety matters and capture the broader vision of road safety management.

In order to achieve a more inclusive road safety management approach, strategic limitations were evident within local policy instruments. While there was a general trend of engaging communities in local planning and design as a prerequisite of sustainable urban development, a positive attitude towards co-design was featured across all development sectors. It did not necessarily ensure a high policy development, and communication and partnership less so—their importance was realised but there was a lack of clarity in communication and partnerships.

Because of the complexity and interconnected land uses, along with the uncertainty and technological change, implementation of the Safe System and Vision Zero principles have remained unsuccessful. Slow adoption and insignificant results in decreasing road crashes in Australian cities
indicate similar stories. While there is a global effort underscoring a more inclusive and pragmatic road safety management approach, a great deal of progress still rests upon engineering solutions in achieving the modern road safety vision. For example, the adoption of roundabouts was widely prescribed for local areas in the PMR to deliver the Safe System outcomes that are mostly focused on vehicle occupants. Such an approach definitely has value in risk reduction in intersections, but can be ineffective in various contexts and is unable to respond to other criteria of the framework. The policy instruments in local government should deliver clear guidelines on the transitional pathway to sustainable mobility and Safe System outcomes while respecting local circumstances and promoting shared responsibility.

8. Conclusions

We acknowledge that many programmes and projects contain various overarching strategies and policy guidelines in local government jurisdiction. While the principles of sustainability and community engagement have become the panaceas of local development, road safety is not frequently featured in this context. However, it is contended that there is a greater possibility of eventual adoption of such principles across all councils. The 4C Framework was developed based on the evolution of road safety strategies and emerging concerns. The framework considered mixed-use development in the metropolitan context but is, of course, subject to major disruptions and lifestyle changes. The criteria proposed within the framework will play a pivotal role in promoting a context-sensitive outcome [4], where new technologies, user preferences, and transport systems will emerge in response to unexpected challenges [17,68] that are beyond the scope of even the latest road safety strategies today. This 4C Framework aims to reframe how road safety is viewed and managed in the community today so that it is future-oriented.

As a means of reaching the above objective, we recommend some short-term strategies:

- Undertake more educational programmes through workshops/conferences and roundtable discussions to enable local government planners and engineers to better understand wider policy objectives and their implications in the local context.
- Ensure a clear funding structure for the local governments to channel wider policies into local strategies.
- Conduct studies to understand the popular narratives of road safety policies within the community.
- Work with various stakeholders to develop a shared language of road safety measures to ensure their consistent application across the PMR.
- Along with behavioural control measures, encourage mutual respect and a shared mentality among road users, and motivate them to contribute to road design.
- Councils with an established built environment require to reform their resource management plans to revitalise and restore infrastructure that can accommodate recent sustainable mobility strategies. It is also imperative across the councils to host new technologies in the transport sector.
- Finally, encourage regional cooperation towards managing road safety issues on local roads. It promotes coherent policy translation and shared interventions. Such cooperation can be developed on an ad hoc basis (e.g., Voluntary Regional Organisation of Councils) where a formal regional council is absent.

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