Medicon Engineering Themes
Volume 9 Issue 2 August 2025
Article Type: Review Article
ISSN: 2834-7218

Technology Innovation People and System Thinking Model (TIPS™): An Innovative Concept 9 to Minimise Road Accidents: A Case History from the Rising use Motorbike in South Africa

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Received: June 26, 2025; **Published:** September 02, 2025

DOI: 10.55162/MCET.09.294

Abstract

This article explores the intersection of technological innovation, commercialization, and regulatory challenges in the automobile industry, with a focus on youth-targeted mobility services. The rising use of motorbikes in South Africa, particularly in KwaZulu-Natal, has been accompanied by a surge in road accidents and fatalities. This study explores the relationship between increased motorbike usage and accident trends from 2020 to 2023, analysing the key contributing factors such as inadequate rider training, non-compliance with traffic regulations, and insufficient infrastructure. Findings reveal that regions like eThekwini experienced a sharp increase in accidents, while areas such as uMgungundlovu showed a decline, highlighting the role of targeted safety interventions. Other districts, notably Zululand and King Cetshwayo, reported zero accidents, although this may reflect underreporting rather than actual absence. The study employed a quantitative, descriptive design using secondary data sources, including government reports and emergency service records. Analysis suggests that rapid commercial motorbike use is particularly prevalent for delivery services. Recommendations integrate the use of a TIPS Model to enforcement of stricter rider licensing, improved road infrastructure, and enhanced public education on motorbike safety. Limitations include the lack of differentiation between user types and the exclusion of contextual variables like weather and road design. The study's implications are significant for policymakers, suggesting urgent reforms to improve motorbike safety and reduce fatalities. Environment. Stakeholders can foster a safer transport environment by implementing comprehensive training, stricter enforcement, and better infrastructure. The findings underscore the critical need for ongoing research and data collection to tailor effective interventions that mitigate motorbike-related accidents' human and economic costs in KwaZulu-Natal and broader South Africa.

Keywords: Motorbike-related injuries; Legality of operators; Risk factors; Swift delivery services; KwaZulu-Natal

Introduction

The rapid advancement of technological innovations within the automobile industry has significantly transformed the landscape of modern transportation. These innovations have not only introduced sophisticated commercial features that appeal particularly to younger demographics but have also expanded access through various government and private sector incentives aimed at promoting economic inclusivity and social upliftment (Monye et al., 2023). However, this wave of commercialization often characterized by fast-paced, time-bound service delivery and incentive-driven feedback mechanisms has unintentionally contributed to the erosion of

adherence to safety protocols and traffic regulations (Ehsani, Michael, & MacKENZIE, 2023). The fragmented involvement of multiple governmental departments and private stakeholders, coupled with inconsistent regulatory enforcement, has further enabled systemic inefficiencies and opportunities for corrupt practices (Scholtz & Yesufu, 2025). Consequently, despite progress in mobility solutions, the global incidence of motorcycle-related accidents and road injuries continues to rise, underscoring the urgent need for more integrative, ethically grounded, and enforceable transport policy frameworks (Mesic, 2023).

In recent years, South Africa has experienced a significant increase in motorbike usage, particularly in urban regions such as KwaZulu-Natal. This surge has been accompanied by a concerning rise in road accidents and fatalities involving motorcyclists (IOL, 2017; News24, 2018). Understanding the factors contributing to this trend is essential for developing effective interventions to enhance road safety.

Motorbike-related accidents impose substantial human and economic costs. In 2023, road crashes resulted in 11,883 fatalities and cost the South African economy approximately R205 billion, accounting for 2.74% of the country's GDP (Swisher Post, 2023). These figures underscore the need to address motorbike safety to reduce these losses and improve public health outcomes.

Increased accidents and fatalities have accompanied the escalation in motorbike usage. Factors such as inadequate rider training, non-compliance with traffic regulations, and insufficient use of protective gear contribute significantly to this issue. For instance, in 2017, South Africa recorded 641 motorcycle crashes requiring emergency or law enforcement intervention, resulting in 520 injuries and 166 fatalities (IOL, 2017). Notably, preliminary findings indicated that rider error was the primary cause in 77% of these crashes (Swisher Post, 2023).

To mitigate motorbike-related accidents, a multifaceted approach is required, such as the implementation of comprehensive training programs focusing on road safety and defensive riding techniques, strict enforcement of traffic laws to deter risky behaviours, encouraging consistent use of helmets and other protective equipment among riders, and developing motorbike-friendly road infrastructures, including dedicated lanes and clear signage (PMC, 2020). In order to structure and advance the mitigation strategy a system thinking (TIPS) is used as model approach.

Globally, motorbike safety has been extensively studied, highlighting factors such as rider behaviour, environmental conditions, and vehicle characteristics contributing to accidents (PMC, 2020). However, gaps remain in understanding the effectiveness of specific interventions across diverse cultural and infrastructural contexts.

In South Africa, research indicates a high incidence of motorbike accidents, with rider error identified as a primary cause. For example, between August 2017 and August 2018, there were 726 motorcycle accidents, resulting in 187 fatalities, with 72% of these accidents involving other vehicles (News24, 2018). Nonetheless, region-specific studies are scarce, particularly in KwaZulu-Natal, examining the interplay between increased motorbike usage and accident rates.

This study aims to fill existing knowledge gaps by comprehensively analysing motorbike usage and associated accident trends in KwaZulu-Natal. The findings will inform policymakers and stakeholders in developing targeted strategies to enhance motorbike safety, thereby reducing accidents and fatalities.

By addressing these critical issues, South Africa can improve road safety outcomes and alleviate the economic burden of motorbike-related accidents.

The study is therefore organised as follows: Literature review, methodology, discussion of results, conclusion, and recommendations.

Literature Review

The Demand for Motorbikes as a Cost-effective Mode of Transport

The mobility issues in sub-Saharan Africa (SSA) have led to the emergence of commercial motorbike transportation. However, regulating this mode of transport has become a contentious battle between two stakeholders: critics and proponents. (Marija, 2022). Rapidly growing cities worldwide depend on informal transport services for mobility needs. (Sengers & Raven, 2014). In sub-Saharan Africa (SSA) population growth, urbanisation, and social change have created a rapid demand and diversifying mobility needs to meet the urban and rural transportation needs. Companies cutting costs and maximising profits have stimulated the emergence of new cheaper modes of transport, for example, delivery bikes and more evident in other African countries (|Nigeria, Mozambique) the motorcycle taxi (Ehebretcht, et al., 2018). In South Africa, the rapid increase in motorbike use for commercial and recreational purposes is creating significant challenges for the health sector. Additionally, there are concerns about the ability of South African road users to handle the growing number of motorbikes (Starkey, 2016). According to Moneyweb (2024), the mighty Checkers Sixty60 on-demand grocery delivery service rumbles on, with sales up nearly 11-fold (10.7x) in the latter half of 2023 versus the last six months of 2020. This ramp-up has also accelerated the demand for motorbikes.

Public Policy Implications of the Use of Motorbikes

In France, the massive shift to motorbikes from regular cars and subways has occurred without any public policy support (Kopp, 2011). Kopp (2011) indicates that public policy could easily further improve the cost-benefit balance by taking measures that would decrease the number of accidents caused by the use of motorbikes. In most developed economies with established transport policies, motorbike users must undergo formal training. Upon completion, they receive valid certification confirming their competency to operate on various roads, allowing them to contribute effectively to the area's economic development (Gumel, et al., 2017). Contrary to the findings in France, studies in Nigeria indicate a lack of proper training and insufficient management by authorities in licensing motorbike users (Gumel, et al., 2017). In the SA scenario, the licensing of motorbike use has been properly regulated and controlled. In general, motorbikes were mainly used for leisure, but never this rapid growth. The growth of motorbikes has raised serious public policy issues globally (Pucher, et al., 2007). Some of the challenges are: 1) the legality and compliance of the operators, 2) the safety of the motorbikes, 3) the safety of public roads, including road conditions, and 4) the preparedness of EMS to respond to the increasing case numbers.

An extensive search and literature review provide the importance and benefits of motorbikes as a public transport mode. However, in this study, the main focus is on the rapid demand side aspects, user organisations regulations, public policy enforcement and regulation, and safety, health and environmental impacts consideration. According to Ehebrecht et al. (2018), countries such as Nigeria and Tanzania, the associated policy changes and other regulatory factors, such as mismanagement of state services, contributed to the dismantling and decline of state-owned transport companies. At the same time, the gap created by policy failures created an entrepreneurial opportunity, which stimulated the emergence of alternative, privately organised modes of transport in the form of motorbikes. (Ehebrecht, et al., 2018).

The government faces the challenge of providing affordable, safe, and accessible public transport to South Africa's townships and communities amid rapid urbanisation, migration, and financial pressures on public services (Walters, 2013). Few formal studies have been conducted on the impact of motorbike use and its implications for public policy and regulation in South Africa.

Use of Motorbikes In South Africa

Developing the motorbike market in South Africa is a multifaceted phenomenon driven by evolving consumer preferences, technological advancements, local contextual factors, and broader economic conditions. This confluence of factors necessitates a strategic approach in terms of regulatory management, monitoring, evaluation, and response in terms of emergency response, job creation to local communities where they are in demand for commercial use (Stastista, 2024). Annual motorcycle sales have nearly doubled in the

past five years, primarily due to demand for commercial motorbikes. The COVID-19 pandemic spurred e-commerce and accelerated the commercial delivery industry, driving this growth (Droppa, 2021).

Figure 1 Graph Indicating Increase in Units Sold from 2020-2022.

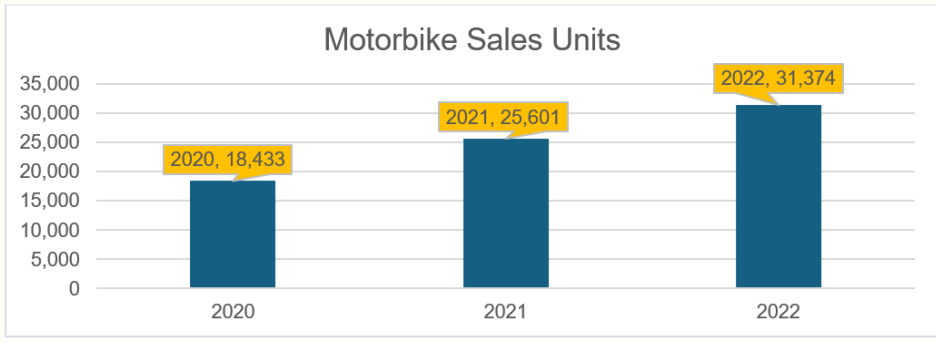


Figure 1: Indicates the continual growth of motorbike sales in SA over three years. *Source*: Droppa 2021.

The market saw significant growth from 2020 to 2022. This could be attributed to various factors, such as economic recovery post-pandemic and increased consumer spending, which resulted in a shift in market demand. Despite the substantial growth over the past few years, current sales levels (31,374 units in 2022) are still significantly lower than the historical peak of 84,000 units sold in 1981. This trend might indicate the broader economic conditions, changes in consumer behaviour, technological advancements, market competition, and other socio-economic factors over the decades.

Motorbike Accidents in SA

According to DSC (2024), motorcyclists represent almost 2.1% of registered road users in South Africa. These figures show nearly 700 accidents a year, according to data from 2021 records. Data also indicated a fatality rate from 166 in 2017 to 183, a year-on-year increase of more than 10%. The noted causes of the accidents include lousy road conditions, enforcement of the law and driver negligence (DSC, 2024).

Health Impact of Motorbike Accidents

Globally, road traffic injuries are among the leading causes of death, mainly resulting in lifelong disability and property damage (Dema, 2019). Road traffic accidents/crush injuries, and fatalities constitute significant health, economic and developmental challenges for many African countries.(Chan, 2010). In the United States of America in 2021, 83,000 motorcycle riders sustained injuries, with 468 injuries occurring per 100 million Km travelled for that year (Bieber, 2022). Motorcyclists face 28 times the chance of dying in a fatal accident and four times the injury risk compared with those in passenger cars. With the increasing motorbike community in SA, the risk profile demonstrates a need for a shift in public policy and regulations to be more preventative and combat the unintended outcomes of this growing "biker community". Similarly, in terms of using bicycles, a recommendation is made that a campaign to increase the use of bicycles would be expected to reduce the number of cycle accidents. This could be adapted to the same approach in the motorbike industry (Simpson & Mineiro, 1992).

TIPS Model Approach as a Mitigation Strategy

Technology innovation people and system thinking model (TIPS) is a framework that integrates forward thinking and empowers policy makers (Mugadza & Marcus, 2019). System thinking as an approach that is essential in the methodological approach for driving organisational change, strategic mastering and innovation (Gholami, 2025). System thinking as a framework dive into the fundamental principles and practical implications including application to various situational approaching approaches. However, in applying system thinking in this case the TIPS model focuses on highlighting operational innovation synergy and integration strategies to in addressing complex, multifaceted problems and change need to mitigate high rise of motor bike accident incidents (Te Brömmelstroet, 2024). The grounding approach or theory in this study is the used of all aspects of TIPS framework in formulating mitigation strategy to motorbike accidents in KZN laying the foundation for the entire South Africa and African continent.

Methodology

This study employed a quantitative, descriptive research design using secondary data to analyse trends in motorbike accidents, injuries, and fatalities in KwaZulu-Natal (KZN) from 2020 to 2023. The study focuses on identifying patterns, causes, and the impact of increased motorbike usage on road safety. Data Collection Secondary data was collected from government reports, such as the Road Traffic Management Corporation (RTMC), the KwaZulu-Natal Department of Transport, and local municipal road safety reports. Police Records: South African Police Service (SAPS) accident reports. Healthcare and Emergency Services: Hospital admissions and emergency response data related to motorbike injuries. Academic and Industry Publications: Studies, reports, and articles from transport research institutes.

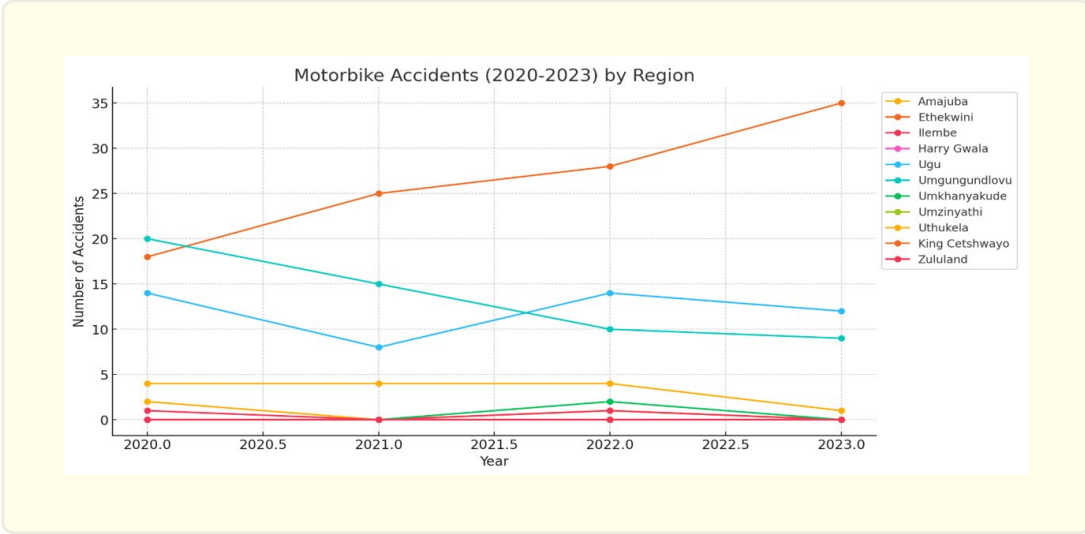
Data Analysis

Over the years, descriptive statistics were applied to analyse motorbike accident data in KwaZulu-Natal (KZN) between 2020 and 2023. The analysis focused on accident frequencies, types of injuries, and fatalities. Measures such as counts, percentages, means, and standard deviations were used to summarise the characteristics of the accident data. To identify patterns over time, trend analysis was conducted, examining the annual variations and determining whether there were increases or decreases in accident rates across periods. This allowed for significant shifts or persistent patterns in motorbike accident outcomes. All data were obtained from official and verified sources, including government traffic departments, police accident reports, and published safety databases. The statistical analysis was performed using Microsoft Excel for basic data cleaning, organisation, and graphs. Additionally, IBM SPSS Statistics (Version 28) was used for more advanced trend analysis, including time series plots and inferential statistics where needed.

By combining descriptive and trend analysis methods with reliable software tools, the study provided a comprehensive overview of motorbike accident dynamics in KZN from 2020 to 2023.

Results

The line graph shows the trend of motorbike accidents from 2020 to 2023 across different regions.



The line graph presents a comparative analysis of motorbike accident trends across selected districts in KwaZulu-Natal from 2020 to 2023. The data reveals significant spatial and temporal variations in incident rates. Notably, ***eThekwini*** exhibits a marked upward trajectory, with reported motorbike accidents increasing from 18 in 2020 to 35 in 2023. This ***94% rise*** over four years suggests escalating motorbike usage, urban congestion, or potential lapses in enforcement of road safety regulations.

In contrast, ***uMgungundlovu*** demonstrates a consistent decline in accident frequency, decreasing from 20 incidents in 2020 to 9 in 2023. This downward trend may reflect improved safety interventions, successful public awareness campaigns, or declining motorbike prevalence within the district.

The ***Ugu*** district shows a relatively stable trend, with annual accident numbers fluctuating modestly between 12 and 14 cases. This indicates a relatively constant risk exposure, possibly influenced by static traffic volumes or moderate levels of road safety compliance.

Interestingly, districts such as *Zululand* and ***King Cetshwayo*** reported ***zero motorbike accidents*** throughout the observation period. While this could be attributed to highly effective safety measures, it more plausibly reflects ***lower motorbike penetration rates*** or underreporting in these predominantly rural or less urbanised areas.

Overall, the data underscore the need for ***region-specific road safety strategies***, especially targeting high-risk urban centres such as eThekwini, while also encouraging continued investment in surveillance and reporting mechanisms in districts with anomalously low or zero recorded incidents.

Discussion

The study highlights significant regional variations in motorbike accident trends across KwaZulu-Natal between 2020 and 2023. eThekwini experienced a sharp increase in motorbike accidents, rising from 18 incidents in 2020 to 35 in 2023. This trend is consistent with broader national and global observations, where the surge in motorbike-based delivery services, particularly during and after the COVID-19 pandemic, has negatively impacted road safety (Swisher Post, 2023; Bieber, 2022). The COVID-19 lockdowns intensified reliance on delivery services, substantially increasing the number of motorcycles on the roads (Droppa, 2021). Factors such as the intense pressure on delivery riders to meet strict deadlines, inadequate licensing, and insufficient rider training have been widely

cited as major contributors to the rising accident rates (Gumel et al., 2017; Enertech et al., 2018). The Motorcycle Safety Institute of South Africa (MSISA) reported a 30% increase in accidents involving food delivery drivers between May and June 2020 compared to the same period in 2019 (MSISA, 2020), further confirming the link between commercial motorbike use and safety risks. These findings suggest an urgent need for targeted interventions, including stricter rider training programs, improved licensing regulations, and investment in motorbike-friendly infrastructure (PMC, 2020; Kopp, 2011).

In contrast, uMgungundlovu exhibited a notable decline in motorbike accidents, from 20 to 9 over the same period. This positive trend may reflect the success of localized interventions such as enhanced law enforcement and road safety campaigns initiated by organisations like the South African Motorbike Transport Association (SAMTA) and infrastructural improvements (Walters, 2013). Research indicates that consistent enforcement of traffic regulations and improved road conditions can significantly reduce accident rates among motorbike users (Pucher et al., 2007). However, further research is needed to verify the specific factors behind this decline and explore whether similar interventions could be replicated in other regions.

Ugu presented a relatively stable accident pattern, fluctuating slightly between 12 and 14 accidents annually. This consistency could indicate steady motorbike usage without major shifts in user behaviour or environmental factors (Simpson & Mineiro, 1992). Minor variations might reflect localized factors such as seasonal changes, enforcement practices, or road maintenance levels. Targeted, proactive interventions, including community-specific road safety campaigns and periodic infrastructure assessments, are recommended to sustain or improve safety outcomes.

Meanwhile, the consistent absence of reported motorbike accidents in Zululand and King Cetshwayo may suggest lower usage, potentially due to different socioeconomic or infrastructural conditions compared to urban centres like eThekwini. However, it may also reflect issues with accident underreporting, which has been noted as a concern in less densely monitored regions (Chan, 2010). Accurate, comprehensive data collection is essential to validate these findings and ensure that potential safety issues are not overlooked.

The findings reveal a complex interplay of social, infrastructural, and regulatory factors influencing motorbike accidents across KwaZulu-Natal. They emphasize the importance of a multifaceted strategy — involving enhanced rider education, stricter licensing and enforcement policies, infrastructure investments, and continuous data monitoring — to improve motorbike safety outcomes and mitigate the economic and human costs of road accidents in South Africa (Dema, 2019; Ehebrecht et al., 2018).

Conclusion

The study on motorbike accidents in KwaZulu-Natal (2020–2023) reveals significant regional variations in accident trends. eThekwini recorded the highest and steadily increasing number of accidents, reflecting the growing reliance on motorbikes, particularly for delivery services. In contrast, uMgungundlovu showed a notable decline in accidents, possibly due to improved safety interventions. Ugu maintained a stable trend, indicating consistent motorbike usage, while Zululand and King Cetshwayo reported zero accidents, which may be due to lower motorbike presence or underreporting.

The findings highlight the urgent need for targeted road safety interventions, particularly in high-risk areas like eThekwini. Addressing issues such as inadequate rider training, poor infrastructure, and enforcement of traffic laws can significantly reduce motorbike accidents, injuries, and fatalities.

Recommendations

To improve motorbike safety across KwaZulu-Natal, a holistic approach aligned with the TIPS model be adopted. Policy enhancements must include the introduction and enforcement of stricter safety regulations, such as mandatory training and licensing requirements for all riders, supported by regular monitoring and tougher penalties for traffic violations, especially in high-risk areas like eThekwini. Infrastructure improvements, such as designated motorcycle lanes and better road maintenance, are critical in reducing accident risks. Accurate and comprehensive data collection in underreported districts like Zululand and King Cetshwayo will help

shape responsive policies. From a Technology perspective, integrating smart traffic systems and helmet-mounted safety features could further enhance rider protection. Lastly, Socioeconomic interventions, including targeted public education campaigns and community outreach, will foster a culture of safety and awareness among both riders and the public. By aligning interventions across these key areas, KwaZulu-Natal can establish a safer and more sustainable motorbike environment

Limitations of the Study

Several limitations were noted in this study. First, regions like Zululand and King Cetshwayo may report lower accident figures due to inadequate data collection rather than an actual absence of accidents. Second, the study does not distinguish between different types of motorbike users, such as delivery drivers, daily commuters, or recreational riders, which limits the depth of analysis and understanding of user-specific risks. Third, important contextual variables weather conditions, road design, and interactions with other vehicles were not accounted for, even though these factors could significantly influence accident trends. Finally, because the research focused exclusively on KwaZulu-Natal, its findings may not be directly generalisable to other provinces like Gauteng, where transport patterns and infrastructure may differ. While the issue the study noted driver training as one of the issues to be addressed the study did not investigate the nationality of the accidents victims and could not identify that foreign driver permits are also contributing to the rise in accidents.

Due to legal constraints and ethical considerations, the use of individual case histories was not feasible for this study. While the researcher acknowledges that including such narratives could have enhanced the depth, validation, and triangulation of the findings, the protection of participants' rights and adherence to research ethics took precedence. This decision aligns with standard ethical research protocols that prioritize confidentiality and the minimization of potential harm to participants

Implications of the Study

The findings of this study provide valuable evidence for policymakers to implement stricter regulations improving motorbike safety, particularly in densely populated urban areas. Authorities can leverage these insights to prioritise road infrastructure improvements and allocate resources more effectively toward building safer transport systems. Moreover, the study highlights the need for further research to explore the impact of specific interventions, such as the use of protective gear, modifications in road design, and the implementation of structured rider training programs, on accident reduction. By adopting these recommended measures, stakeholders can enhance overall road safety, lower motorbike accident rates, and contribute to a more efficient and sustainable transportation system for motorbike users in KwaZulu-Natal and potentially across South Africa.

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