

# Assessing Road Risks for Goods Transportation on South Africa's Johannesburg-Durban N3 Corridor

Sambil Charles Mukwakungu<sup>1,\*</sup>, Nita Sukdeo<sup>2</sup>, Werner Beukes<sup>3</sup>, Charles Mbohwa<sup>4</sup>

<sup>1</sup>Department of Quality and Operations Management, University of Johannesburg, Johannesburg, South Africa, Orcid: 0000-0003-3073-0410

<sup>2</sup>Department of Quality and Operations Management, University of Johannesburg, Johannesburg, South Africa, Orcid: 0000-0003-4126-9682

<sup>3</sup>Department of Quality and Operations Management, University of Johannesburg, Johannesburg, South Africa.

<sup>4</sup>Department of Quality and Operations Management, University of Johannesburg, Johannesburg, South Africa, Orcid: 0000-0002-8268-5984

## Keywords

Road accident

Driver behaviour

Road risk

Traffic volume

Transport.

---

## Abstract

The N3 Gateway, extending from Johannesburg to Durban, is a vital link for freight transportation to the East Coast for export. This road plays a vital role in South Africa's economy; however, it is not exclusively used for freight transport, but is also a vital link for travellers wishing to visit the coastal areas in Durban. This road is characterised by high traffic volumes on road accidents; however, other risks are associated with this road. This paper aims to assess the various road risks from the perspective of road freight transport. A quantitative approach was employed for this study. A self-administered questionnaire served as the data collection tool; the questionnaire was designed according to the five-point Likert scale design. The findings revealed that the N3 gateway has many other risks and hazards apart from road accidents; they include criminality and driver behaviour as high-risk factors.

---

---

\*Corresponding Author

<sup>1</sup>\*sambilm@uj.ac.za

<sup>2</sup> nsukdeo@uj.ac.za

<sup>3</sup> wernerbeukes84@gmail.com

<sup>4</sup> cmbohwa@uj.ac.za

# 1. Introduction

In the modern day's highly dynamic and globalized economy, transport is greatly increasing, and this has created the need for effective and efficient transport operations. Sakhapov et al. (2016) argued that the accessibility of a dependable and well-organized transport system is a fundamental issue in the socio-economic development of any country. Transporting freight (products and goods) is a key component of supply chain organizations and consequently a vital economic driver. The success of businesses, supply chains and economies, therefore, to a great extent, depends on a reliable transport system. Jenelius and Mattsson (2012) argue that the road transport system is one of the most important industries of modern society because of its ability to connect spatially separated locations, which then provides accessibility.

The importance of the road network is evidenced in the proportion of the total volume of passenger and cargo moved by road vehicles; the N3 plays a significant role in road transport (Sakhapov et al., 2016). Roughly, about 30% of the vehicles traveling on the entry are trucks or heavy vehicles; Bergville, Keeversfontein and Van Reenens carry more than 40% of these vehicles. Traffic volumes average vary significantly per day and between 8500 and 13500 vehicles travel on the entry per day and in peak times, more than 2000 vehicles travel on the N3 per hour along sections (Boucher, 2022). This study made use of a case study of the N3 corridor; a survey questionnaire was employed to collect the data. The purpose of the case study was to conduct a comprehensive assessment of road risks and associated challenges pertaining to goods transportation on South Africa's Johannesburg-Durban N3 Corridor.

## 1.1. Problem Statement

South Africa has a very bad reputation when it comes to the road death tolls. More than 1400 people died on road in South Africa during the 2022 December festive season (Mbalula, 2023). The transport industry is anticipated to show growth between 200% to 250% in the coming years, thus, road fatalities are expected to increase accordingly (Verster and Fourie, 2018). The transportation of goods is an important part of the supply chain and economic success; However, there are various challenges faced on the roads by transport operators (Ben Abdallah, Belloumi and De Wolf, 2013; Sakhapov et al., 2016). These challenges include road accidents, criminal acts, hijackings, high traffic volumes, poor road infrastructure and other related incidents. Road risk negatively affect various operational aspects such as costs, delays, and good security.

In goods transport, planning and route selection are one of the measures to operate efficiently; Thus, transport operators need to be aware of the extent of risks on the road networks on which they operate. This helps them plan for, anticipate, and prevent any risks that may occur (Zhu et al., 2019). To protect themselves from the road risk, transport operators need to be aware of the potential risk on the road networks they operate in. This study focused on analyzing the N3 corridor between Johannesburg and Durban to identify and access the risk on this corridor.

## **1.2. Background, Rationale and Value of the Study**

This research is valuable to transport operators; it provides insight into the risk associated with road transport operations on a major road route in South Africa. This will enable such operators to plan for, and reduce, or prevent the impact of these road risks. Awareness of this road risks enables operators to ultimately reduce operational risks, prevent operational failures and maintain the quality of the freight throughout the transportation process. This research will contribute to the body of existing knowledge of literature pertaining to road transportation.

The evaluation and risk assessment of the N3 Corridor assessed potential hazards, road safety, road surface issues (construction, potholes, and gravel on the road surface). This route was investigated in terms of a broad and inclusive research; it involved an empirical study as well as a literature review pertaining to road transport. The choice of the N3 corridor is because it runs through Johannesburg, South Africa's financial hub, and serves as a vital link to the remainder of the nation from the Port of Durban (Pillay and Geyer, 2016; SA, 2017; Nkabinde, 2021; Silaule, 2021).

This study should enable transport organisations to improve road transport operations in the sense that planners will now be aware of the different physical risks, which may hamper the transportation of goods on the N3 and thus, decrease accidents, deliver improved outputs, efficient operations and cost savings.

## **1.3. Research Aim, Objectives and Questions**

### **1.3.1 Research Aim**

The aim of this study is to evaluate and assess the risk related to accidents and especially, risks related issues pertaining to road transport on the N3 gateway. The analysis and assessment of risks on the N3 corridor will help predict the impact of risk in the road system, to determine where hazards are the most likely to ensue and where the consequences would be the most severe.

### **1.3.2 Research Objectives**

The research is pursuing the following research objectives referred to as RO for the purpose of this study:

- RO<sub>1</sub>: To rate three variables (hijacking, robbery/theft, and assault) to assess the probable occurrence of criminality on the N3.
- RO<sub>2</sub>: To investigate the scope and type of service failures experienced in road freight operations due to inefficient road infrastructure.
- RO<sub>3</sub>: To access the general attitudes of drivers on the N3 and how these attitudes contribute to road risks.
- RO<sub>4</sub>: To evaluate which areas on the N3 can be classified as hotspots for truck drivers (hotspots refer to places and stretches of road on the entry deemed as too risky to stop all overnight).

### **1.3.3 Research Questions**

From the above research objectives, the following research questions referred to as RQ for the purpose of this study were formulated:

- RQ<sub>1</sub>: What is the rate of three variables (hijacking, robbery/theft, and assault) to assess the probable occurrence of criminality on the N3?
- RQ<sub>2</sub>: What is the scope and type of service failures experienced in road freight operations due to poor road infrastructure?
- RQ<sub>3</sub>: What are the general attitudes of drivers on the N3?
- RQ<sub>4</sub>: Which areas can be deemed as hot spots and should preferably be avoided by truck drivers?

### **1.4. Scope and Limitations of the Study**

The study focused on identifying elements, which contributes to negative outcomes from a transport organization's viewpoints. Transport organizations suffer major losses due to road transport incidents on the N3. Top of this list are road accidents, theft of cargo, hijackings, loss/damage to goods, vehicle damage and other elements which lead to inefficient transportation of goods. In order to achieve these objectives, a questionnaire was designed with the specific emphasis on identifying road infrastructure that leads to accidents; these may include dangerous curves, poor driving habits, poor road surfaces, inadequate visibility, absence of road signs, poor road markings, heavily congested road traffic, and other factors.

The study's limitation is its focus on the N3 corridor alone, making the findings possibly not generalizable to other corridors, and some risks may not have been identified. The paper focuses on the identification and assessment of risks on the N3 corridor between Johannesburg and Durban to help predict the impact of risk in the road system, to determine where hazards are the most likely to ensue and where the consequences would be the most severe, as such the paper started with an introduction section providing the background, aim, objectives as well as questions including the scope and limitation of the study. The introduction is followed by the literature review which provides the gap in the literature this study is attempting to fill. The literature review is then followed by the methodology the researchers have followed to achieve the research objectives and answer the research's fundamental questions. The result section is used to present the finds of the study obtained through the analysis of the data collected through the research tool. The findings are then discussed under the dedicated discussion section which is followed by the conclusion which provides the final words on the study.

## **2. Literature Review**

The literature review section of this study identifies a gap in research specifically focusing on road infrastructure and risks along the N3 corridor in South Africa. Previous studies from different regions

have explored factors such as fatigue-related accidents among truck drivers, road safety, national risk assessment models, road conditions, road-related criminal activities, and causes of road accidents. However, there is a lack of research addressing the N3 corridor directly. To address this gap, the authors conducted a gap analysis and selected relevant journal articles published between 2002 and 2018. The review emphasizes the importance of road transport in South Africa, its impact on the economy, and the need for sustainable management. Visual illustrations and statistics are provided to enhance understanding of the context and significance of the research.

## 2.1 Gap Analysis

A research design is an overall strategy in which the researcher integrates several studies that were identified in the body of knowledge in relation to the research topic. However, none of them directly focused on road infrastructure and road risks and hazards, particularly from a South African perspective. Several studies have been identified and have been summarized in Table 1 which presents the studies' main findings. Notably, the table highlights a lack of research with reference to the N3.

**Table 1: Literature Gap**

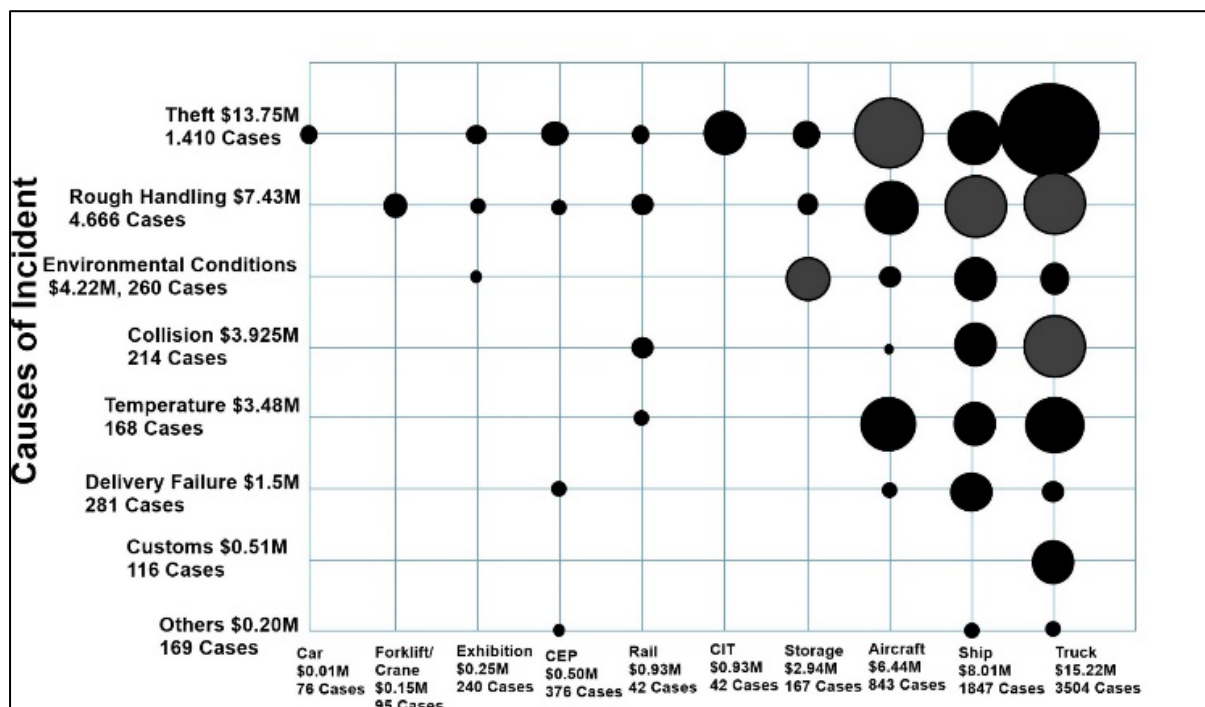
Ref	Summary Findings	Where
	Context of the Study	
Maldonado et al., 2002	Long-haul truck drivers' illegal long working hours cause fatigue-related accidents, posing a risk to road safety.	South Africa
	<b>Context:</b> Driving time vs. resting time	
Shah et al., 2018	Six factors impact road safety: funding, institutional structure, substructures, legislation, vehicle conditions, and human behavior/distress management.	Asian region
	<b>Context:</b> Relationship between road safety and finance, legislation, vehicular and human impact	
Jurewicz and Excel, 2016	The Australian National Risk Assessment Model (ANRAM) evaluates critical road crash risks across road networks, assisting governmental agencies in meeting national strategic framework objectives.	Australia
	<b>Context:</b> A model that predicts road crashes	
Dreyer and Steyn, 2015	Rough roads raise vehicle operating expenses by increasing fuel usage, tyre wear, and maintenance costs.	South Africa
	<b>Context:</b> Road surface impact pertaining to buses	
Wright and Ribbens, 2016	Road-related criminal activities negatively impact road safety and the broader network system.	South Africa
	<b>Context:</b> High Road traffic accidents linked to high crime levels	
Verster and Fourie, 2018	Fatal accidents are caused by unlicensed and/or unroadworthy vehicles and substandard road environments.	South Africa
	<b>Context:</b> An investigation into high death rates in terms of road fatalities	
Roberts, 2014	Road accidents are caused by the absence of tolerance among road users, tired drivers, and truck drivers lacking advanced driving skills.	South Africa
	<b>Context:</b> Evaluation of safety requirements for long-haul truck drivers.	

The analysis framework was based on journal articles published between 2002 and 2018, chosen exclusively based on the keywords "N3, Road Safety, Road Accidents, Goods Transport and Road

Transport Threats". The analysis considered the summary findings, context of the study, geographical region where the study was conducted, and areas for future research (Author, Year).

## 2.2 Road Transport Hazards

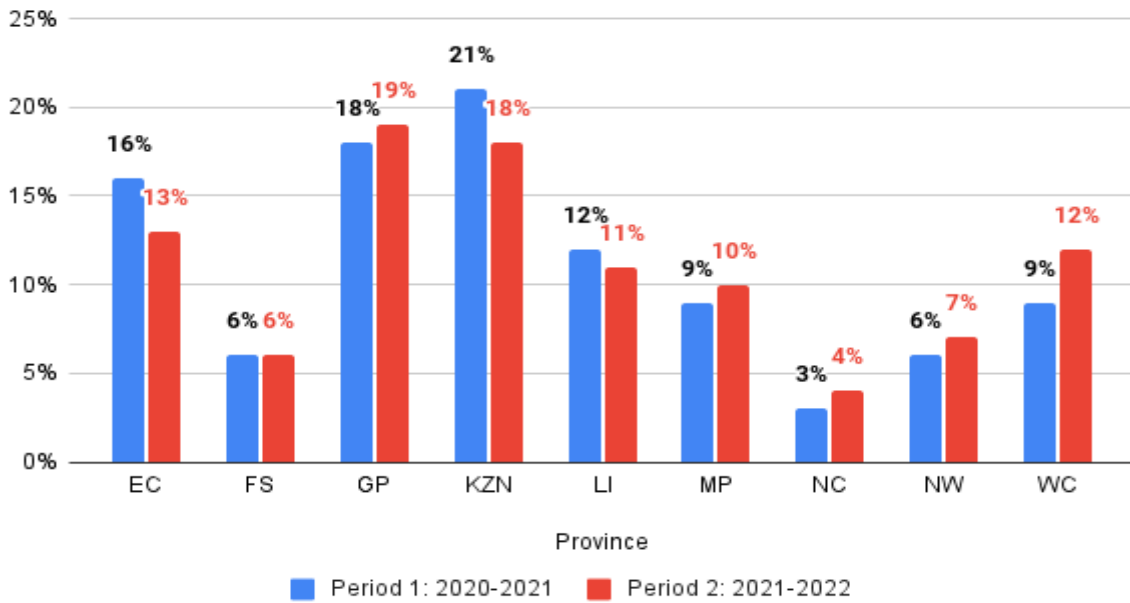
Road accidents claim 1.3M lives worldwide yearly and may rank 7th for causes of death by 2030 (World Health Organization, 2022). A study of 7,284 transport insurance claims over 4 years, including aircraft, ship, and truck delivery showed that theft, rough handling of goods, and collisions were major incidents, with trucking having the most theft and road transport presenting the most risks (Figure 1) (Skorna, Bode and Weiss, 2011).



**Figure 1: Road Risks**

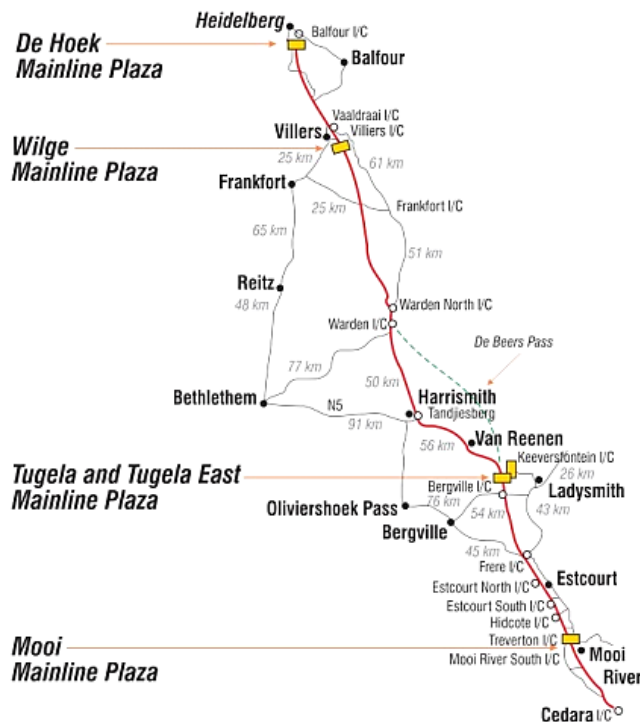
Source: Skorna, Bode and Weiss (2011).

From a South African viewpoint, one of the significant road risks relates to fatalities, and a large number of fatalities (on average 14 000) every year (Rondganger, 2021), contains a blend of various road users, from drivers to travelers to people on foot and cyclists. As depicted in Figure 2, which shows the statistics of fatal crashes in South Africa distributed per province between the years 2020 and 2021, as well as the years 2021 and 2022, KwaZulu Natal (KZN) and Gauteng Province (GP) are the provinces with the most road crash fatalities with KZN topping this grim chart in the two periods (Business Tech SA, 2022). KZN has seen a decline of 3% from 21% road crash fatalities in the period 2020-2021 to 18% between 2021 and 2022, while Gauteng has seen an increase of 1% from 18% in the period 2020-2021 to 19% between 2021 and 2022 (Business Tech SA, 2022).



**Figure 2: Road Crash Fatalities in South Africa per Province**  
 Source: Business Tech SA (2022).

### 2.3 N3 Corridor



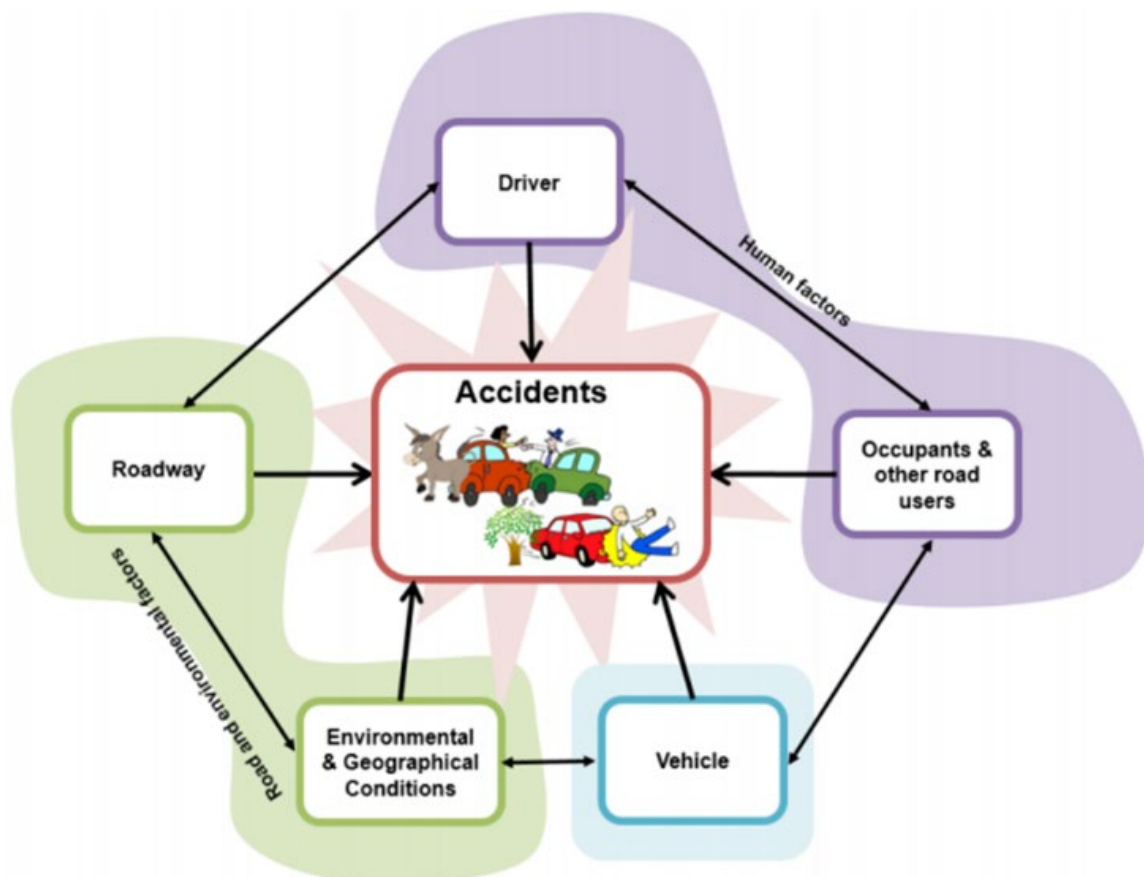
**Figure 3: Roadmap of the N3 Corridor**  
 Source: (Arrive Alive, 2019).

The N3 Toll Route, illustrated in Figure 2, connects the Heidelberg (Toll Plaza) in Johannesburg and the Cedara (Toll Plaza) in KwaZulu-Natal. It spans approximately 600km and passes through four of

South Africa's major provinces, namely Gauteng, Mpumalanga, Free State, and KwaZulu-Natal, forming a corridor that links Johannesburg (the economic hub) to the important port in Durban (Arrive Alive, 2019).

## 2.4 The Road Transportation Dynamics of South Africa

It has been stated that compared to other means of transport, the road carries the majority of the freight in South Africa (Akinlabi and Mbohwa, 2016). South Africa's economy depends on the road transport industry and the development and maintenance thereof to meet its economic growth plan (Verster and Bouwman, 2020; Akinlabi and Mbohwa, 2016). However, there are issues that affect the logistics industry and other sectors that rely on cargo logistics for their organisations. Transporting freight by road exposes carriers and users to risk of traffic accidents and road incidents (Batarlienè, 2008). See Fig. 3 for a visual illustration of road hazards and risks.



**Figure 3: Road Transportation Dynamics**

Source: Skorna, Bode and Weiss (2011).

The road transport mode is preferable in South Africa, where 85% of transport initiatives were done by road transport mode, and only 13% was attributed to rail mode in 2012 (Havenga, Simpson and Goedhals-Gerber, 2017). South Africa finds itself in this position due to an over-reliance on road transport, and not enough attention is given to this strategic resource in terms of sustainable management (Havenga et al., 2016).



### **3. Research Methodology**

#### **3.1 Research Design**

When a research design is considered, research philosophies need to be considered for this process. The comprehension of the different research philosophies together with the various advantages and characteristics allow the researcher to be more resourceful and exploratory in terms of the method of research (Saunders, Lewis and Thornhill, 2019). For this research, the researcher opted for a quantitative research approach. A quantitative approach was selected to gain insight into the underlying perspectives of people in terms driver behaviour and attitudes that is related to road risks.

#### **3.2 Data Collection**

Data in this research was collected using a survey, where truck drivers were surveyed along the N3 route at the different truck stops. The survey questionnaire was aimed at collecting first-hand information about risks experienced by truck drivers. These risks included physical danger to drivers (muggings, violent theft, hijacking, et cetera). The other risks pertaining to other road users, include potential risky habits by other road users, the role the environment played in contributing to risks and hazards, and specific poor road infrastructure that may lead to accidents or damage to vehicles. The survey was also designed to identify possible improvements in terms of road infrastructure and other suggestions that may reduce risk factors on the N3.

#### **3.3 Population and Sampling**

The population consisted of all the drivers of goods for commercial purposes travelling on the N3 between Johannesburg and Durban; this population is known as the target population (Alvi, 2016). The sampling strategy consisted of a purposive sampling, which is a non-probability concept. For the purposes of this research, commercial drivers, specifically those driving trucks driving regularly on the N3 were considered for this study. Non-probability sampling is employed in situations whereby the research population has intimate knowledge that will offer deeper insights into the research phenomenon (Alvi, 2016).

For this study, truck drivers employed by good transportation organisations were considered because of their intimate knowledge of the N3. The participants consisted of 30 randomly selected truck drivers, who were requested to complete the questionnaire whilst the researcher was travelling on the N3. Truck drivers were targeted at resting places, for example, truck stops. This sample size was conveniently chosen from the company where the study was conducted and the size of the sample is supported by previous studies (Cohen, Manion and Morrison, 2011, p.93; Sharma, 2020)

#### **3.4 Reliability**

Cronbach's Alpha is commonly used to assess internal consistency and measuring how reliable Likert scale questions are. This test correlates the research instrument's items and deliver a score that indicate how reliable the instrument is (Karakaya and Alparslan, 2022; Bruin, 2006). The questionnaire

comprised of questions/statements that are accurate, based on the latest literature. The instrument that was used in this study accurately measured what is desired for the study. A further test which was performed was the Cronbach Alpha test, which was done to assess the measure of internal consistency, in order to establish how closely related a set of variables are as a group (Karakaya and Alparslan, 2022). This test was then employed to measure construct reliability.

### 3.5 Ethical Considerations

A questionnaire was used by the researcher to gather data from the study's participants. The implication was that ethical issues needed to be considered. The learning institution's ethical clearance, which specified the guidelines, circumstances, and requirements for the research, was first acquired and followed by the researchers. It is crucial to note that the specific faculty where the study was conducted had not yet provided an ethical clearance certificate with a reference number at the time this study was being finalized. The participant's safety and avoidance of unneeded stress were always the researchers' top priorities. It was made a priority to avoid unethical behaviour since it makes participants and researchers feel exposed and vulnerable in undesirable ways.

The reliability and validity of the data that is gathered can potentially be jeopardized by unethical behavior (Hasan et al., 2021). Furthermore, privacy and secrecy, informed consent, fairness, autonomy, and beneficence were among the ethical principles upheld throughout this investigation (Hasan et al., 2021)

## 4. Results and Findings

### 4.1 Description of the Study Participants

In this study, 30 professional drivers were surveyed, and their demographic profile was analyzed based on four variables: driver status, driving experience, gender, and age. The drivers were all male, with an average experience of 7.86 years, ranging from two to 18 years of experience. Their ages ranged from 27 to 52 years, with a mean age of 40.93, indicating that they were middle-aged to older adults with considerable knowledge of road risks on the N3.

### 4.2 Criminal Activities

**Table 2: Hijacking, Robbery and Assault Statistics**

Variables	Mean	Standard Deviation	Variance	Skewness
Hijacking	4.67	0.76	0.57	-2.39
Robbery	4.70	0.75	0.56	-2.59
Assault	4.37	1.03	1.07	-1.83

The study aimed to evaluate the likelihood of criminal activity (hijacking, robbery/theft, and assault) occurring on the N3 by rating these three variables. To assess the probability distribution of the three

variables, the median was compared to the mean. As shown in Table 2, the mean of the three variables were very close (hijacking with 4.67, robbery theft being 4.7 and assault at 4.37), this indicates that the responses leaned towards a high probability of occurrence of the three variables with robbery being the highest. The skewness of all the variables were negative, thus, the respondents leaned towards very probable.

### 4.3 Factors Contributing to Accidents

Table 3 shows the statistics related to Hijacking, Robbery and Assault. Other Drivers, Poor visibility and Speeding-Other drivers were the most significant variables in terms of factors that contribute to accidents or collisions on the N3 Corridor under study with other drivers being the highest contributors.

**Table 3: Hijacking, Robbery and Assault Statistics**

Variables	Mean	Standard Deviation	Variance
Pedestrians	3.17	1.39	1.94
Farm vehicles	2.80	1.45	2.10
Other drivers	4.55	0.63	0.4
Stray animals	3.41	1.50	2.25
Slippery road surface	3.97	1.22	1.48
High traffic volumes	4.07	1.10	1.21
Slow moving traffic	3.50	1.43	2.05
Other speeding drivers	4.40	0.89	0.80
Taxis	4.00	1.20	1.43
Poor visibility on the road	4.38	0.98	0.98

Farm vehicles were indicated as the lowest risk in terms of sources for accidents/collisions, whilst all the other nine variables played a significant role in accident/collision risks.

### 4.4 Road Geography Risk Factors

**Table 4: Road Geography Risk Factors**

Variables	Mean	Standard Deviation	Variance
Steep downhill	4.31	0.97	0.94
Blind corners	4.15	0.92	0.86
Sharp corners	4.12	1.09	1.19
Winding roads	3.93	0.21	1.07
Steep uphill	3.88	0.26	1.34
Low laying bridges	3.26	0.30	1.56

As displayed in Table 34, all the top five variables fell in the category of somewhat probable with steep downhills being the highest with a mean value of 4.31, whilst low bridges were indicated as lowest factor in road geography risks.

#### 4.5 Road Condition Risk Factors

**Table 5: Road Condition Risk Factors**

Variables	Mean	Standard Deviation	Variance	Skewness
Potholes	4.26	0.90	0.81	-1.24
Poor road signage visibility	3.76	1.30	1.69	-0.75
Gravel/Sand Road	3.70	1.44	2.06	-0.78
Road construction	3.54	1.27	1.62	-0.53
Tar missing	3.50	1.53	2.34	-0.51
Objects on the road	3.46	1.29	1.67	-0.42
Poorly painted road marking	3.39	1.37	1.88	-0.13
Tree branches on the road	3.39	1.52	2.32	-0.59
Water puddles on the road	3.35	1.50	2.24	-0.34

Road Condition Risk Factors are presented in Table 5. The results show that the N3 has two major risk factors, they are criminality and driver error. Driver error was highlighted as one of the main reasons for accidents on the N3. The N3 is also described as a high-volume traffic environment. Some of the stretches of road on the N3, like Van Reenens Pass was identified as the most dangerous stretches of road in terms of road geography.

The many downhills are a particular risk for truck drivers since it was highlighted as one of the sources of accidents. Unroadworthy vehicles and accidents due to unroadworthy vehicles were reported as common.

### 5. Discussion

Certain stretches of the N3 road are considered high-risk areas for truck drivers, who must exercise additional caution or avoid them entirely. Criminal activities such as hijackings, robberies, and assaults are prevalent along these routes, as reported by (Geldenhuis, 2021) and supported by the findings of (Wright and Ribbens, 2016; Kolobe, 2021; Hoffman, Schutte and Rabe, 2022; Geldenhuis, 2023). Drivers often avoid resting or staying overnight at certain locations to protect themselves and their possessions, such as truck tires and personal belongings. Specific areas, including Howick to PMB, Van Reenens Pass, Escort, Mooi River, Villiers, Tugela, and Pietermaritzburg, are highlighted as particularly dangerous, while the entire N3 is regarded as unsafe.

The primary cause of accidents and collisions is human error, including speeding, violating road rules, and impatience. High traffic volumes on the N3 worsens this situation. Although not the focus of this

study, drivers repeatedly mentioned traffic volume as a significant factor in accidents and collisions. Naude and Chitakunye (2014) as well as Nyoni (2017) identified high traffic volumes, reckless driving, and poor visibility as additional factors that contribute to the accident rate.

In terms of road geometry, steep gradients are a major issue for trucks. Van Reenens Pass and Pietermaritzburg were highlighted as areas of concern since these areas are mountainous. These areas have winding roads and blind corners. One stretch of road (Villiers to Harrismith and Warden) is long and straight with no scenery, and the respondents indicated that this road encourages drowsiness or lack of concentration due to its monotony. All these factors constitute risks.

## **6. Managerial Implications and Recommendations**

This research is useful to transport operators, particularly those operating on the N3 corridor; it gives insight into the dangers connected with road transport operations on a key South African route. This will allow such operators to plan for, lessen, or eliminate the effect of such road dangers. Being aware of these road dangers allows operators to decrease operational risks, prevent operational failures, and maintain freight quality throughout the transportation process. This study will add to the corpus of current knowledge in the literature on road transportation.

As per the findings, in terms of risks to consider, robberies should be attended to by equipping vehicles, especially trucks, with GPS tracking devices linked to security companies that can intervene in case risks occur. Furthermore, managers should provide regular training to their drivers and focus on the awareness of other drivers on the road, as these have been identified as the critical cause of accidents on the N3 corridor. One aspect concerning geographical risk factors is that steep downhill must be tackled carefully. Automatic break assistance must be maintained to assist the drivers when engaging on such terrain. Lastly, although potholes are aspects outside the control of companies operating on the N3 corridor, it is essential that drivers are made aware of areas with a high presence of potholes and that the utmost care is given when driving in such areas.

In terms of recommendations, addressing driver behaviour is crucial. The prevalent negative driving style in South Africa, marked by speeding, illegal overtaking, alcohol use, and disregard for rules, contributes to accidents, although this behaviour is mostly displayed by a minority of drivers (Verster & Fourie, 2018). Changing driver attitudes through effective policing and educational initiatives is suggested. Starting driver education at the school level could instil good driving behaviour from the outset. Night driving for transport trucks on the N3 should be minimized due to the risk of criminal activity, particularly hijacking and robbery, often targeting trucks with limited driver presence (Wright & Ribbens, 2016). Specialized SAPS units and private security services could mitigate these risks. Additionally, addressing poor visibility in areas like Van Reenens Pass and Pietermaritzburg through improved road geometry is vital. Technological solutions like Driver Monitoring and Management Software (DMMS) can help companies track driver behaviour and implement corrective measures.

Drones could also be employed collaboratively to monitor the N3 in real-time, enhancing overall road safety and identifying problematic drivers at toll gates (Author, Year).

## 7. Conclusions, Limitations and Future Research

The purpose of this study was to conduct a comprehensive assessment of road risks and associated challenges pertaining to goods transportation on South Africa's Johannesburg-Durban N3 Corridor. The researcher confirmed that the study achieved its aims and objectives and presented detailed justifications for statements using quantitative data.

The study addressed questions related to risk factors, service failures, driver attitudes, and hotspots on the N3. While the study provided insights on risk factors, further research is needed to understand the driving culture in South Africa and to examine criminal activity in more detail. The interrelatedness of risk factors was identified, but further research is necessary to explore how these factors contribute to road accidents.

Given the limitations of this study, it is clear that future research should focus on investigating other routes such as the N1 from the South of the country to Cape Town, initiatives to prevent criminal activity and accidents, and report findings to raise awareness of vulnerabilities and improve strengths. Identifying high accident zones and investigating their causes is crucial, and this information should be communicated to road users to ensure they remain vigilant in these areas. The limitation due to the number of participants should be overcome by considering a larger sample size to allow for generalisation of results. Additionally, future research should consider a Mixed Methods approach to combine both the qualitative and quantitative approaches to bring more insight into the findings of the study.

## REFERENCES

- Akinlabi, S.A. and Mbohwa, C. (2016). Evaluating Operational Challenges of Road Freight System. In: *Proceedings of the World Congress on Engineering and Computer Science*. [online] WCECS. San Francisco, USA: WCECS 2016, pp. 977–981. Available at: [https://www.academia.edu/download/79213617/WCECS2016\\_pp977-981.pdf](https://www.academia.edu/download/79213617/WCECS2016_pp977-981.pdf) [Accessed 24 May 2023].
- Alvi, M. (2016). *A Manual for Selecting Sampling Techniques in Research*. [online] MunichPersonalRePEcArchive. Available at: [https://mpra.ub.uni-muenchen.de/70218/1/MPRA\\_paper\\_70218.pdf](https://mpra.ub.uni-muenchen.de/70218/1/MPRA_paper_70218.pdf) [Accessed 24 May 2023].
- Arrive Alive (2019). *New three-way stop planned at the Cedara interchange (N3/R103 intersections) to improve traffic flow and enhance safety*. [online] Arrive Alive. Available at: <https://www.arrivealive.co.za/news.aspx?i=40031&s=0&page=New-three-way-stop-planned-at-the-Cedara-interchange-N3-R103-intersections-to-improve-traffic-flow-and-enhance-safety> [Accessed 24 May 2023].
- Batarlien , N. (2008). Risk Analysis and Assessment for Transportation of Dangerous Freight. *Transport*, 23(2), pp. 98–103. <https://doi.org/10.3846/1648-4142.2008.23.98-103>.

- Ben Abdallah, K., Belloumi, M. and De Wolf, D. (2013). Indicators for sustainable energy development: A multivariate cointegration and causality analysis from Tunisian road transport sector. *Renewable and Sustainable Energy Reviews*, 25(2013), pp. 34–43. <https://doi.org/10.1016/j.rser.2013.03.066>.
- Boucher, Q. (2022). *Peak traffic times and numbers for this weekend on the N3*. [online] Newcastillian News. Available at: <https://newcastillian.com/2022/12/15/peak-traffic-times-and-numbers-for-this-weekend-on-the-n3/> [Accessed 24 May 2023].
- Bruin, J. (2006). *Newtest: Command to Compute New Test*. UCLA: Statistical Consulting Group.
- Business Tech SA (2022). *These are the most dangerous provinces and roads in South Africa over December*. [online] [Businessstech.co.za](https://businessstech.co.za). Available at: <https://businessstech.co.za/news/lifestyle/651717/these-are-the-most-dangerous-provinces-and-roads-in-south-africa-over-december/> [Accessed 24 May 2023].
- Cohen, L., Manion, L. and Morrison, K. (2011). *Research methods in education*. 7th ed. London: Routledge, p. 93.
- Dreyer, C.M.W. and Steyn, W.J. vd M. (2015). Evaluation of the effect of deteriorating riding quality on bus-pavement interaction. *Journal of the South African Institution of Civil Engineering*, 57(3), pp. 2–8. <https://doi.org/10.17159/2309-8775/2015/v57n3a1>.
- Geldenhuis, K. (2021). When work is no longer safe-brutal attacks on truck drivers. *Servamus Community-based Safety and Security Magazine*, [online] 114(3), pp. 16–21. Available at: <https://journals.co.za/doi/abs/10.10520/ejc-servamus-v114-n3-a5> [Accessed 24 May 2023].
- Geldenhuis, K. (2023). Hijacking: A traumatising experience for victims. *Servamus Community-based Safety and Security Magazine*, [online] 116(2), pp. 18–22. Available at: [https://journals.co.za/doi/pdf/10.10520/ejc-servamus\\_v116\\_n2\\_a6](https://journals.co.za/doi/pdf/10.10520/ejc-servamus_v116_n2_a6) [Accessed 24 May 2023].
- Hasan, N., Rana, R.U., Chowdhury, S., Dola, A.J. and Rony, M.K.K. (2021). Ethical Considerations In Research. *Journal of Nursing Research, Patient Safety and Practise*, [online] 1(11), pp. 1–4. <https://doi.org/10.55529/jnrpsp11.1.4>.
- Havenga, J., Simpson, Z. and Goedhals-Gerber, L. (2017). International trade logistics costs in South Africa: Informing the port reform agenda. *Research in Transportation Business & Management*, 22, pp. 263–275. <https://doi.org/10.1016/j.rtbm.2016.08.006>.
- Havenga, J.H., De Bod, A., Simpson, Z.P., Viljoen, N. and King, D. (2016). A Logistics Barometer for South Africa: Towards sustainable freight mobility. *Journal of Transport and Supply Chain Management*, 10(1). <https://doi.org/10.4102/jtscm.v10i1.228>.
- Hoffman, A.J., Schutte, P. and Rabe, S.J. (2022). Novel system for the monitoring of in-transit compliance of freight trucks. In: *2022 IEEE 25th International Conference on Intelligent Transportation Systems (ITSC)*. [online] Macau, China: IEEEExplore, pp. 2220–2226. <https://doi.org/10.1109/itsc55140.2022.9922304>.
- Jenelius, E. and Mattsson, L.-G. (2012). Road network vulnerability analysis of area-covering disruptions: A grid-based approach with case study. *Transportation Research Part A: Policy and Practice*, [online] 46(5), pp. 746–760. <https://doi.org/10.1016/j.tra.2012.02.003>.
- Jurewicz, C. and Excel, R. (2016). Application of a Crash-predictive Risk Assessment Model to Prioritise Road Safety Investment in Australia. *Transportation Research Procedia*, 14(2016), pp. 2101–2110. <https://doi.org/10.1016/j.trpro.2016.05.225>.
- Karakaya, S. and Alparslan, Z. (2022). Sample Size in Reliability Studies: A Practical Guide Based on Cronbach's Alpha. *Psychiatry and Behavioral Sciences*, 12(3), p. 150. <https://doi.org/10.5455/pbs.20220127074618>
- Kolobe, M.C. (2021). *The effects of burnout on truck drivers: A study of truck drivers in City Deep Johannesburg*. [Master Dissertation] pp. 51–53. Available at:

<https://wiredspace.wits.ac.za/bitstreams/e1bc16c4-c385-48ba-a57e-64100d1c498c/download> [Accessed 24 May 2023].

- Maldonado, C.C., Mitchell, D.G., Taylor, S. and Driver, H.S. (2002). Sleep, work schedules and accident risk in South African long-haul truck drivers: research in action. *South African Journal of Science*, 98(7), pp. 319–324.
- Naude, M. and Chitakunye, P. (2014). Factors that contribute to road accidents caused by heavy commercial vehicles: a South African perspective. *Journal of Contemporary Management*, [online] 11(1), pp. 431–450. Available at: <https://journals.co.za/doi/pdf/10.10520/EJC158215> [Accessed 24 May 2023].
- Nkabinde, D. (2021). N2 and N3 are vital arteries of the South African Economy. *The Mercury*. [online] 15 Dec. Available at: <https://www.pressreader.com/south-africa/the-mercury-south-africa/20211215/281827172071741> [Accessed 20 Aug. 2023].
- Nyoni, R. (2017). *A GIS based approach to identify road traffic fatal accident hotspots in the greater Durban city from 2011-2015*. [MSc Dissertation] Available at: [https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/15853/Nyoni\\_Rudolphine\\_2017.pdf?sequence=1&isAllowed=y](https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/15853/Nyoni_Rudolphine_2017.pdf?sequence=1&isAllowed=y) [Accessed 25 May 2023].
- Pillay, X. and Geyer, H.S. (2016). Business clustering along the M1-N3-N1 corridor between Johannesburg and Pretoria, South Africa. *South African Journal of Geomatics*, 5(3), p.340. <https://doi.org/10.4314/sajg.v5i3.6>.
- Roberts, C. (2014). *Profiling the Safety Needs of the South African Truck Transportation Sector*. [Master Dissertation] pp. 39–40. Available at: [http://dspace.nwu.ac.za/bitstream/10394/11960/1/Roberts\\_C.pdf](http://dspace.nwu.ac.za/bitstream/10394/11960/1/Roberts_C.pdf) [Accessed 24 May 2023].
- Rondganger, L. (2021). South Africa's roads deaths are a 'national crisis'. *IOL*. [online] 24 May. Available at: <https://www.iol.co.za/news/south-africa/kwazulu-natal/south-africas-roads-deaths-are-a-national-crisis-cefc54fe-bafe-45c6-b0d9-f7c4b1ce7ea8> [Accessed 24 May 2023].
- SA, P.C.-A. (2017). *History of the N3: South Africa's cultural, historical and natural heritage*. [online] Life. Available at: <https://www.news24.com/life/archive/history-of-the-n3-south-africas-cultural-historical-and-natural-heritage-20170923> [Accessed 20 Aug. 2023].
- Sakhapov, R., Nikolaeva, R.V., Gatiyatullin, M.H. and Marat Makhmutov (2016). Risk management model in road transport systems. *Journal of Physics: Conference Series*, 738(1), pp. 012008–012008. <https://doi.org/10.1088/1742-6596/738/1/012008>.
- Saunders, M., Lewis, P. and Thornhill, A. (2019). *Research Methods for Business Students*. 8th ed. Harlow: Pearson.
- Shah, S.A.R., Ahmad, N., Shen, Y., Pirdavani, A., Basheer, M.A. and Brijs, T. (2018). Road Safety Risk Assessment: An Analysis of Transport Policy and Management for Low-, Middle-, and High-Income Asian Countries. *Sustainability*, [online] 10(2), p. 389. <https://doi.org/10.3390/su10020389>
- Sharma, A. (2020). *Is n = 30 really enough? A popular inductive fallacy among data analysts*. [online] Medium. Available at: <https://towardsdatascience.com/is-n-30-really-enough-a-popular-inductive-fallacy-among-data-analysts-95661669dd98> [Accessed 20 Aug. 2023].
- Silaule, Y. (2021). N3 upgrade projects to benefit KwaZulu-Natal economy and road users. *Engineering News*. [online] 19 Aug. Available at: <https://www.engineeringnews.co.za/article/n3-upgrade-projects-to-benefit-kwazulu-natal-economy-and-road-users-2021-08-19> [Accessed 20 Aug. 2023].
- Skorna, A.C.H., Bode, C. and Weiss, M. (2011). Risk and Loss Prevention within the Transport Chain. In: *20th International Conference on Management of Technology*. [online] International Conference on Management of Technology (IAMOT 2011). International Association for Management of Technology (IAMOT). Available at:



<http://www.vs.inf.ethz.ch/publ/papers/Alexander%20Skorna-riskan-2011.pdf> [Accessed 24 May 2023].

These are the most dangerous provinces and roads in South Africa over December. (2022). *IOL*. [online] 18 Dec. Available at: <https://businesstech.co.za/news/lifestyle/651717/these-are-the-most-dangerous-provinces-and-roads-in-south-africa-over-december/> [Accessed 24 May 2023].

Verster, C. and Bouwman, H. (2020). Land-based sources and pathways of marine plastics in a South African context. *South African Journal of Science*, 116(5/6). <https://doi.org/10.17159/sajs.2020/7700>.

Verster, T. and Fourie, E. (2018). The Good, the Bad and the Ugly of South African Fatal Road Accidents. *South African Journal of Science*, [online] 114(7/8). <https://doi.org/10.17159/sajs.2018/20170427>.

World Health Organization (2022). *Road traffic injuries*. [online] World Health Organization. Available at: <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries> [Accessed 24 May 2023].

Wright, G. and Ribbens, H. (2016). Exploring the impact of crime on road safety in South Africa: transportation engineering. *Civil Engineering*, 2016(8), pp. 64–69.

Zhu, L., Yu, F.R., Wang, Y., Ning, B. and Tang, T. (2019). Big Data Analytics in Intelligent Transportation Systems: A Survey. *IEEE Transactions on Intelligent Transportation Systems*, 20(1), pp.383–398. <https://doi.org/10.1109/tits.2018.2815678>.