EFFECTIVE MONITORING OF VEHICLE UTILISATION: A CASE STUDY OF ETHEKWINI MUNICIPALITY FMSs

BY

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ABSTRACT

The effective monitoring of vehicle utilisation in real time in the eThekwini Municipality pose a challenge in service delivery. There is no linkage between the service that is being delivered and the vehicle usage, therefore there is no live measuring of actual versus schedule to control service delivery operations. The deviations from the schedule can only be identified by physical inspections or complaints from the customers. This is after the effect and is deemed as poor service delivery. The study challenges range from poor service delivery and delays in community service. The research problem, therefore, focuses on gaining better understanding of effective monitoring of vehicle utilisation to eliminate unproductive vehicle usage and improve service delivery to the communities.

The need for the study arises from complaints from communities and the ability to monitor if services are delivered to areas as allocated and to eliminate unnecessary overlaps, under or over servicing of areas. The purpose of this dissertation was to establish the feasibility use of intelligent communication technology advances, communication, and fleet monitoring systems at eThekwini Municipality. The study further explains possible obstacles and any significant advantages of effective monitoring to ensure productivity in service delivery to the eThekwini Municipality communities. The study aims to evaluate the effective monitoring of vehicle utilisation in eThekwini Municipality using fleet management systems.

The research adopted a qualitative research approach. In line with the qualitative approach, data was collected using in-depth interviews. Semi-structured interviews were conducted with five participants. In conducting semi structured interviews, the researcher wanted to obtain detailed information about the current fleet management systems at eThekwini Municipality and the participants' perceptions and experiences when it comes to monitoring vehicle utilisation in the workplace. Given that the small sample frame, the criteria was based on employment history within the organisation over a longer period, the knowledge and experience which is deeply rooted withing monitoring sector and selected by means of a purposive sampling method. This sampling technique helps one to gain more knowledge about the individual experiences of participants regarding the investigated phenomenon.

The findings indicated knowledge, ability and performance gaps in information technologies, fleet management system, real time monitoring, vehicle utilisation and fleet management frameworks. The study also found a significant association among the four variables: vehicle utilisation, monitoring, information and communication technologies and fleet telematics. Secondly, as regards the literature review, an extended view on real time tracking for vehicles using several types of intelligent communication technology advancement is illustrated with practical examples to indicate its effective execution in a fleet management system.

Technology is evolving, adapting of new technology can help the eThekwini Municipality to improve system functionality and the ability to develop new, innovative approaches. The study contributed new knowledge to systems theory regarding the information technologies, fleet management system, real time monitoring, vehicle utilisation, fleet management frameworks and these aspects are supported by the findings.

The study recommended adopting innovative technologies to improve fleet management system functionality and the ability to develop new, innovative approaches. The study recommended further the implementing an effective monitoring tool to produce real-time data to assist Fleet Management System Users in live monitoring, a good reporting structure, which can be more interactive in terms of departmental requirements, and a more robust in favourable of the productivity of the system. The study concludes by presenting recommendations from the research results for future studies on technology advancement in terms of real time application.

The study of a single department (City Fleet Unit) within eThekwini Municipality's is a limitation and any attempt to escalate findings to other department should be done upon approval by the Head of City Fleet Unit. This does not lessen the significance of this research, as the main purpose of the study was to use this as a case study to understand typical fleet management systems challenges and how technological advancements could help in mitigating systems problems.

Keywords

Fleet management, information technologies, fleet management system, monitoring, vehicle utilisation

DEDICATION

This dissertation is dedicated to my mother, Iris Manozi Tembe; my late father, Boisy Tembe (Mwayi), the Khuluse family, my brothers (Nhlakanipho, Nhlonipho, Nhlanhla and Sbusiso) and lastly the kids. I appreciate your support, even when I doubted my ability to finish this adventure.

The words of inspiration kept me going because I had become discouraged along the route.

DECLARATION

I, Nonhlanhla Tembe, declare that: -

(i) The research reported in this dissertation, except where otherwise indicated, is my original work.

(ii) I am familiar with the rules regulating higher qualifications at the Durban University of Technology (DUT) and understand that DUT will deal with violations of ethical practice in my research.

(iii) Any research of a similar nature that has been used in developing my research project is also referenced.

(iv) This project has not been submitted to any other educational institution for qualification.

(v) All subsidy-earning output (publications) from postgraduate studies will follow the intellectual property policy of DUT.

(vi) I understand that I am expected to publish an article based on my research results; and

(vii) I understand that plagiarism is wrong and incurs severe penalties.

I HEREBY DECLARE THAT THE ABOVE FACTS ARE CORRECT.

_____ DATE: NOVEMBER 2022

Signature by Student

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

CAGR:	Compound Annual Growth Rate
ECU:	Electronic Control Unit
FM:	Fleet Management
FMS:	Fleet Management System
MaaS:	Mobility-as-a-Service
AI:	Artificial Intelligence
ICT:	Information and Communication Technology
GPS:	Global Positioning System
GSM:	Global System for Mobile
IoT:	Internet of Things
GIS:	Geographical Information System
OTR:	Off the Road
RFID:	Radio Frequency Identification
RTA:	Road Traffic Act
SOE:	State Owned Enterprises

LIST OF ANNEXURES

CHAPTER ONE: INTRODUCTION TO THE RESEARCH STUDY

1.1 Introduction to the research study

According to Ebinowen and Umaru (2020), the fleet industry is one of the most important industries in the world. The pressure to deliver services to eThekwini Municipality communities has made effective monitoring of vehicle utilization an important aspect of fleet management, Gitahi and Ogollah (2014). Better vehicle utilization lowers operating cost through better planning. Planning requires effective fleet monitoring system with the aim to determine routes that will provide the highest overall utilization of vehicle capacity to improve service delivery. According to Ramirez et al. (2018) and Banister et al. (2019), the search for an effective technological platform is crucial to implement technological advancements.

More recently a special emphasis is made to find better dynamic solutions to vehicle dispatching as well as to vehicle routing under non-stationary system state. Effective monitoring systems, according to (Redmer, 2016), can improve system performance overall by considering the highly stochastic environment in which such fleet management system technology develops. Authors like Grunow et al. (2006) and Krzyzanowska (2007) highlighted the significance of monitoring the driver behavior in the internal and frequently congested areas to achieve the required effective monitoring of vehicle utilisation using fleet management systems. Grunow et al. (2006) and Krzyzanowska (2007) further explained that the simulation or analytical models utilized must account for the very unpredictable and varied travel time caused by vehicles in the congested areas.

The current fleet size is approximately 8000 vehicles which are managed effectively through exceptions based on operational parameters. The fleet environment has evolved in technology over the past few years. Vehicles have standard sensors and interfaces which provide real time information/data. The problem within the Ethekwini Municipality there are various systems that are used to manage and maintain the current fleet, but none of them can be used to integrate to the vehicle sensors and interfaces effectively monitor vehicle utilisation.

The core responsibility of any municipality is to ensure infrastructure is maintained and services are delivered to its citizens. To maintain such infrastructure and deliver such services a vehicle is always required. A municipality's fleet becomes one of the most critical tools to deliver these services. According to section 40 (1) of the Constitution of the Republic of South Africa (Act 108 of 1996), the national, provincial, and local domains of government are distinct from one another and are

interdependent and related. With a duty to rule, provide services (electricity, houses, roads, and water and sanitation etc.) to promote social and economic growth. The Constitution, which acknowledges that municipalities have a developmental as well as a service role in addressing the fundamental needs of communities and improving service delivery, served as the inspiration for this study.

The study identifies and evaluates effective monitoring methods of vehicle utilisation using aspects of fleet management systems of eThekwini municipality. The study objectives are achieved by conducting a literature review on the aspect of fleet monitoring and vehicle utilisation. This research will use the qualitative research approach which will involve the engagement of fleet systems administrators in eThekwini Municipality, City Fleet Unit to gather essential data for analysis, interpretation, and provision of recommendations for this study. In this study, the participants are selected by means of a systematic random sampling method. The criteria are based on work experience within the work environment's fleet systems and operations area.

1.2 Background of research study

Both at the national and local levels of the nation and the world economy, fleet management and logistics are major contributors. The fleet management sector supports the economy, enabling efficient service delivery to commuters. The principal responsibility of any municipality is to ensure that infrastructure is maintained, and services are delivered to its citizens. A vehicle is always required to maintain and deliver such services. A municipality's fleet becomes one of the most critical tools to deliver these services.

The fleet environment has evolved in technology over the past few years. Vehicles have standard sensors and interfaces which provide real-time information and data. Various systems are used to manage and maintain the current fleet. The fleet management system is one of the systems that monitor vehicles, driver behaviour, fuel etc.

Knowing movement of vehicles are, what the drivers are doing, and monitoring vehicle utilisation are the critical parameters for a well-managed decision-making process, Saghaei (2016). Chiparo et al. (2022) indicated that the advancement of fleet management technology, a communications system and state of the art management techniques plays a vital role in the development of transport network, sustainability, and adaptable service demands.

Bnouachir et al. (2020), in numerous contexts, fleet management systems are utilised to coordinate service delivery and mobility. Chiparo et al. (2022) further highlighted that to ensure optimal utilisation of the fleet, it is mandatory to monitor the utilisation of the fleet operated by municipal departments to tie back to service delivery. Information technology of Fleet management will add value in improving planning, reducing vehicle abuse, minimising wasted trips and appropriately allocating resources.

EThekwini Municipality offers a range of services to municipal residents, namely: water services, electricity services, community participation, health services, road maintenance, and fire and emergency services, to name a few. In this context, fleet management is essential in ensuring optimum fleet utilisation.

At the end of vehicle life cycle, the City Fleet Unit department of the eThekwini municipality must acquire, manage, and dispose. Fleet of the Municipality in accordance with the SCM procedures in place to provide effective, affordable, and dependable vehicle and plant solution to allow the various Units to fulfil service delivery mandates. The City Fleet Unit is responsible for procuring, maintaining, and managing the eThekwini Municipality's fleet. The fleet size has grown over the last few years to almost 8000 vehicles, which are used by various service departments within the eThekwini Municipality. The fleet ranges from:

i. Vehicles
ii. Buses
iii. Fire Engines
iv. Compactors
v. Trucks
vi. Specialised Trucks, i.e., Hook Lift, Water Tankers, Fuel Trucks etc.
vii. Plant i.e., TLBs, Excavators, Tractors etc.

City Fleet Vehicle Monitoring Service Centre (VMSC) operates on a 24-hour, 365 days. Its main objective is to safeguard municipal vehicles by providing effective monitoring, thus eliminating abuse and theft of municipal vehicles. The centre handles emergencies and queries like the reporting of breakdowns, accidents, hijackings, incidents, complaints, driver identification and management, vehicle tracking and monitoring.

The study intended to add value to the municipal department of the City Fleet to improve the monitoring system and overall performance of the system to ensure optimisation of the fleet.

1.3 Problem statement

Monitoring vehicle utilisation is important to ensure satisfactory vehicle availability, reduction in costs of running the fleet and effective service delivery, John (2019). According to Kebande et. al. (2021) an intelligent real-time monitoring of vehicle utilisation and its location through the GPS is to provide reliable and affordable intelligent fleet monitoring system. Kebande et. al. (2021) further pointed that through the advance technologies like Internet of Things (IoT) and Cloud Computing fleet management systems can improve productivity in monitoring vehicle utilisation.

It has been established that there is no effective tool for monitoring vehicle utilisation. As a result, fleet systems administrators cannot reallocate non- and under-utilised vehicles on a real-time basis to improve availability, effectiveness, and efficiency of vehicle utilisation. Secondly, **t**here is no effective monitoring application if the services are delivered within an area the vehicle is allocated to, which specifies that there is no real-time alert. Thirdly, there is no way of analysing vehicle movements across the areas or identifying if these movements are productive, dead, or unproductive kilometres. Physical inspections or customer complaints can only identify any deviations from the schedule. This is after the effect and is deemed as poor service delivery.

Considering the problems have a detrimental impact on the community, all potential solutions should be explored. This could be mitigated using technological advancements that can efficiently monitor vehicle utilisation on a real-time basis. The advanced fleet monitoring application with IoT have previously assisted other governments, municipalities and fleet businesses that have experienced similar difficulties. Thus, the research to be conducted to evaluate the effectiveness of the fleet management systems as regards to effective monitoring of vehicle utilisation.

1.4 Aim of the study

The aim of the study is to evaluate effective monitoring of vehicle utilisation in eThekwini Municipality Fleet Management Systems. The goal of the study is to determine if it is feasible to use technology advancements on monitoring vehicle utilisation using fleet management systems, to improve service delivery to the eThekwini communities. The aim of a study generalises the purpose and the goal to be accomplished, Tully (2014).

1.5 Objectives of the study

In the current study, the aim was achieved by addressing the following objectives were formulated to address the research problem:

- To evaluate effective monitoring of vehicle utilisation eThekwini Municipality's fleet management system in Durban.
- To explore the root causes of challenges experienced during the monitoring of vehicle utilisation using eThekwini Municipality FMSs.
- To make recommendations on FMS framework to improve effective monitoring of vehicle utilisation on real time basis.

1.6 The research questions

The following research questions were used based on the objectives of this study and the literature review to guide the research. According to Punch (2013), the research questions and analysis plan are the basis from which the data should be structured. The research questions in this study are:

- What are the main challenges in monitoring vehicle utilisation using the fleet management system at eThekwini Municipality?
- How can the root causes of the challenges have experienced during the monitoring vehicle utilisation using eThekwini Municipality FMS be explored?
- What recommendations can be made regarding the implementation of effective fleet management systems application to improve monitoring of vehicle utilisation in eThekwini Municipality?

1.7 Significance of the study

Rojas et al. (2020) stated that vehicle operation is under the direction of the fleet management system, which also monitors and assesses whether scheduled services are being performed. Mehmood (2021), a fleet monitoring system is essential to safeguard fleet and protecting drivers against road accidents to meet requirements for daily business operations. In general, FMS monitors vehicles in real-time, lower hazards, increases service quality, and enhances operational efficiency at a minimal cost.

The study uses a case study within eThekwini Municipality to find the effect of vehicle utilisation using a fleet management (monitoring) system solution. The findings can also assist the Municipality in determining the way forward with evolving technology and by implementing practical monitoring tools to improve monitoring of vehicle utilisation to ensure services are delivered to eThekwini Municipality citizens. Additionally, it is anticipated that the results will add to the body of academic research on fleet management on a global scale. It further encourages municipalities, transport industries and other organisations to adopt innovative technologies in fleet management and real-time monitoring. The study can be published for students and be placed in public libraries and other educational institutions to gain knowledge in the aspects of fleet management academically and in general.

1.8 Delimitations

Delimitations are self-imposed restrictions to the study compared to limitations which, have inherent restrictions to your methodology, Miles and Scott (2017). Theofanidis, Dimitrios, & Fountouki, Antigoni. (2019), added that delimitations are mainly concerned with the study's theoretical background, objectives, research questions, variables under study and study sample. This scope of this study did not include other municipalities in South Africa. The study was restricted to the eThekwini municipality's department of City Fleet Unit. As a result, the findings of this study cannot be generalised to other cities in South Africa. The emphasis of this study is on the application of effective monitoring of vehicle using fleet management systems and its challenges associated within eThekwini municipality.

1.9 Limitations

According to Calabrese (2009) limitations tend to act as an anticipator of the study's flaws. Calabrese (2009) further indicated that limitations are study-related restrictions that are outside of the researcher's control. Moreover, limitations are intrinsic to the study and beyond the researcher's control and may have an impact on how broadly the findings can be applied (Terrell, 2016). The study was limited to the City Fleet Unit of eThekwini Municipality's and any attempt to escalate findings to other department should be done upon approval by the Head of City Fleet Unit. This does not lessen the significance of this research, as the main purpose of the study was to use this as a case study to understand typical fleet monitoring of vehicle utilisation using fleet management systems challenges and how technological advancements could help in mitigating fleet monitoring problems.

1.10 Research methodology

The goal of the qualitative methodology is to comprehend a complicated world and the significance of actions in each situation. According to Flanagan (2013), the scientific method is the most effective way to learn about the world's truths, investigate novel theories, and carry out empirical tests of those beliefs. According to Maxwell (2013), qualitative research explores the world of meanings, motives, aspirations, beliefs, values, and attitudes, which equates to a deeper realm of relationships, processes, and phenomena that cannot be reduced to the operationalization of variables. Creswell (2014) stated that research is a design framework or guide for the researcher to follow. This process includes the approach, methods and techniques that will be used to carry out the research.

The research adopted a qualitative research approach. In line with the qualitative approach, data was collected using semi-structured interviews. Semi-structured in-depth interviews were conducted with five (5) participants. This type of interview involves posing a series of open-ended questions to participants and then following up with probing questions to explore further into their thoughts on the research study. In conducting interviews, the researcher wanted to obtain detailed information about the current fleet management systems in eThekwini Municipality and the participants' perceptions and experiences when it comes to monitoring vehicle utilisation in the workplace. Given that the small sample frame, the criteria was based on employment history within the organisation over a longer period and selected by means of a purposive sampling method. This sampling technique helps one to gain more knowledge about the individual experiences of participants regarding the investigated phenomenon.

The study consisted of five chapters that were arranged from the introductory chapter to the conclusion. Figure 1 below depicts the layout of the study as follows:

1.11 Structure of the dissertation

This study consists of six chapters with each briefly summarised as follows:

Figure 1: A graphic outline of the chapters in this study.

Chapter 1: Introduction

This chapter provides a summary of the study, aims, objectives, the research problem, its importance, and research questions.

Chapter 2: Literature review

The existing aspects of fleet management knowledge is the main topic of the literature review. The literature review focuses on fleet management, fleet management systems, communication technology applications, fleet monitoring, vehicle utilisation and the advances of a real time system.

Chapter 3: Research methodology

This chapter focuses on providing an overview of the research paradigm, target population, sampling strategy, and data gathering techniques after data analysis.

Chapter 4: Presentation and analysis of results

In this chapter focuses are on managing the data collected, data analysis and presenting of result of the research topic which the data was collected by distributing questionnaires and conducting interviews to gather information on the case study.

Chapter 5: Discussion and interpretation of results

The result of the study is described in depth in this chapter, along with the presentation and interpretations of the survey results. The results of the surveys and interview questions will be presented in detail, along with interpretations of the results.

Chapter 6: Conclusion and recommendations

Chapter 6 provides a conclusion, recommendations for both academics and practitioners, limitations of the study, and the areas that need further research on this topic, especially in the FMS. The recommendations arise from the findings of this study.

1.12 Conclusion

This chapter served as an introduction to the study, providing background information and a summary of the study many components. The chapter went on to discuss the research problem, as well the study aim, objectives, and research question. The significance of the study is specified, and organisation of the chapters is outlined.

The following chapter provides a thorough account of the assessment of literature on fleet management and fleet management systems. It also discusses potential barriers to monitoring vehicle utilisation to maintain productivity in service delivery to the residents of the eThekwini Municipality.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A fleet encompasses moving vehicles and plant, or a combination of fleet vehicles or transport (Akkartal & Aras, 202). Akkartal & Aras (2021) defined fleet management as events that start from planning and costing to vehicle acquisition and disposal. Akkartal & Aras (2021) indicated that every organisation in the world today uses vehicles including those in the pharmaceutical, IT, food and beverage, delivery, manufacturing, other service, government, and local authority sector. Hennigan (2022) and Akkartal & Aras (2021) has indicated that fleet management is used by companies that depend on transportation to monitor vehicle usage, driver behaviour, fuel management, and compliance. Monnerat et al. (2019) specified that considering homogenous or heterogeneous vehicles, fleet management encompasses decisions about fleet configuration, allocation, and vehicle routing. Monnerat et al. (2019) further added that fleet management allows companies that rely on fleet to minimise the risks associated with vehicle investment, improve efficiency, and improve productivity.

Fleet management comprises several tasks to keep vehicles and operations running smoothly and efficiently, Hennigan (2022). Ebinowen & Umaru, (2020) mentioned several functions that can be included in fleet management, including driver management, vehicle monitoring, vehicle maintenance, fuel management, and health and safety management. Mehmood (2021) suggested that effective fleet monitoring practices to be explored to reduce and minimise overall costs, maximise cost-effective utilisation of resources and better customer satisfaction results. Some essential capabilities are customer service, asset management and accurate and timely data reporting (Mehmood, 2021).

According to Chiparo et al. (2022), the majority of SOEs worldwide are dealing with budget minimisation while still having to maintain key service delivery requirements with the best fleet possible. Similarly, although having noble intentions, governmental fleet management in many African countries has historically been less effective that private businesses, Chiparo et al. (2022).

According to Kebande et. al. (2021) vehicle utilisation is a requirement that describes the general performance or use of fleets. It is a comparison of demand to fleet capacity or threshold is being compared. The demand and capacity can fluctuate, simply fleets that are used to the fullest potential in different areas with different vehicle classes at different times. Begashaw & Temesgen (2018) added that business organisations can organise and coordinate fleet of operational vehicles to increase productivity, minimise expenses, and ensure compliance with legal requirements.

According to Insight (2017) fleet monitoring, vehicle maintenance, vehicle telematics, driver management, fuel management, and health and safety management are just few of the tasks that can be included in fleet management. Shaheen et al. (2016) & Archetti et al. (2017) stated that in one way or another, fleet management is frequently connected to the goal of effectiveness.

The eThekwini municipality has been facing with several complaints from the community about the misuse of the municipal fleet, delays in service quality, fuel theft, accidents, bad driving habits and noncompliance which have an impact on the management of the fleet. Fleet monitoring is the overall management of a collection of assets vital to a business operation (TitanGPS, 2020). With, Fagerberg (2016) advised companies to explore technology advancements of fleet monitoring systems that entails comprehensive details of the aspects of fleet monitoring of vehicle utilisation in real-time basis. Bnouachir et al. (2020) added that fleet technology enhancements solution to manage the fleet's vehicles regarding in line with business process such as tracking dispatching of vehicles, route management, real time alerts, communications, and other related fleet management navigation in a single system to curb noncompliance in service delivery to the communities. According to Fagerberg (2016) highlighted that fleet management systems form part of fleet management and is defined as a vehicle-based system that incorporates data logging, satellite positioning and data communication to a back-office application.

This chapter also covers the aspects of fleet management, fleet monitoring technologies and types of fleet management technologies that were explored in detail. Further information technology advancements that can benefit fleet management methods were described in the literature review. Finally, it outlines the various features and cases of fleet management monitoring and the need for fleet management systems enhancement to ensure optimal fleet utilisation. This chapter unpacks the theoretical framework for the study. It further evaluates the literature review of fleet management and the effectiveness of monitoring vehicle utilisation using a fleet management system. This chapter

further examines literature and case studies related to frameworks or strategies used in fleet management industries and technological advances that have radically changed industries.

2.2 Fleet Management

According to Redmer (2016) vehicles are the primary resource used to meet transportation requirements both internally (transportation activities performed by no transportation businesses) and externally (transportation services provided by common carriers). Redmer (2016) indicated that vehicles (transportation means) are used by a given company to satisfy its in-house or outside transportation requirements which is called a fleet. An appropriate fleet management is a key factor to a successful management of all transportation activities in a company by Akkartal & Aras (2021). Fleet management is a term that describes the practices and technologies used by companies to manage their commercial vehicle fleets. This includes a range of activities such as vehicle maintenance, fuel management, driver safety and logistics planning by Avetisyan and Skibniewski (2017).

The goal of fleet management is to increase operational efficiency, reduce costs and improve overall fleet performance, Arya (2022). Fleet management solutions can involve software, GPS tracking systems, telematics and other advanced technologies to provide real-time insights that help companies optimise their fleet operations, (TitanGPS, 2020). Kersten et al. (2017) has pointed out that weak logistics practices particularly vehicle fleet management have caused delays in the implementation of government services and projects, thereby derailing service. Most government sectors globally, are faced with poor service delivery while at the same time, having to provide the most suitable fleet in support of core service delivery requirements, Fourie and Poggenpoel (2016). In the same way, public sector fleet management in many African countries, have despite good intentions, generally been less efficient than private firms, Fourie and Poggenpoel (2016).

Despite adopting technology, most government sectors in South Africa face serious challenges in implementing service delivery options that enhance existing structures towards service delivery, Fourie and Poggenpoel (2016). Ampiah (2018) observed that public entities are challenged by frequent vehicular breakdowns, accidents as well as poor vehicular scheduling. Naif (2017) argues that even though there are laws and policies framework governing fleet operations, there is non-compliance to asset management regulations in public entities. It is imperative to understand the role of fleet management within organisations and subsequently the role of vehicle usage to ensure that service delivery to the communities.

2.3 Fleet Management Industry

According to Bnouachir et al. (2020) there are plenty of ways to optimise service delivery and minimise expenses even though the fleet plays a supporting rather than a leading role. Fleet Management includes fleet acquisition, vehicle tracking, vehicle maintenance, driver management, fuel management, fleet monitoring and safety management, Qvintus (2019). With these functions, fleet management is considered one of the most important aspects of fleet management (Frotcom, 2020). Software applications are also connected with fleet management systems to simplify repetitive chores and improve worker effectiveness (Fleet Management System Market: Global Industry Trends, Share, Size, Growth, Opportunity, and Forecast, 2021-2026). (Insight, 2022). Indicated that fleet management systems can assist to control fuel and maintenance costs, it provides fleet managers real time fleet access, extended the life of vehicles, and improve customer and driver satisfaction,

Insight (2017) indicated a strong growth period for fleet management in South Africa in the years to come. The number of FM systems in active use is forecasted to grow at a compound annual growth rate (CAGR) of 12.6 percent from about 2.0 million units at the end of 2021 to reach 3.6 million units by 2026. The penetration rate in the total population of fleet vehicles used by businesses is at the same time estimated to increase from 41.5 percent in 2021 to 68.0 percent in 2026. South Africa is a relatively mature telematics market and the penetration rate is comparably high from an international perspective. Far from all deployments are however full-scale advanced FM solutions. A notable share of the installed fleet telematics systems on the South African market is represented by comparably low-end tracking systems, e.g., light FM solutions, including SVR systems extended with basic FM features.

The fleet management systems are widely used in the energy and utility, automotive, manufacturing, retail, construction, organization, and transportation industries because of these advantages (Fleet Management System Market: Global Industry Trends, Share, Size, Growth, Opportunity, and Forecast, 2021-2026). According to Qvintus (2019), fleet managers should consider many factors to ensure smooth operations of the business. From choosing suitable vehicles and drivers, they are ensuring safety, increasing efficiency, and staying compliant with legal requirements, i.e., RTA. and focusing on the fleet management aspects as depicted in figure 2.1.

Figure 2: Important aspects of transportation and fleet management
Source: (Qvintus, 2019)

According to Hennigan (2022) purchasing vehicles for a company's fleet can be complicated. The necessary fleet and the different fleet kinds are just two of the numerous factors to consider. Consider the pros and cons of leasing versus purchasing vehicles as well as the cost of the fleet management services before selecting a provider. (Hennigan, 2022). Utilization of fleets or individual vehicles is merely a requirement that describes how fleets are used or performed. Measuring fleet performance or use entails measuring fleet utilisation. Demand and fleet capacity are compared to determine fleet utilization. The method used to manage it changes on daily bases as capacity and demand do. A properly utilized fleet increases profitability in addition to productivity improvement and cost

reductio (Frotcom, 2020). Therefore, companies should consider fleet management system as an important application for monitoring vehicle movement. The process of installing fleet monitoring devices adds value to the business operation to know whereabouts of the vehicle. The fleet monitoring devices are installed by technicians into fleet and companies can access any vehicle's real-time location and movement (Frotcom, 2020). Fleet managers can access the fleet data using a specialized telematics system to know exactly where the vehicles are, where they were when the journey started, where they stopped, and for how long. In addition to increasing output, customer service can be enhanced (Peerbits, 2022). Which is an important monitoring tool to eThekwini municipality in monitoring its vehicle utilisation. Smart track (2020) added that fleet management systems also provide a function to track and evaluate driving patterns, whereby organizations can analyze acceleration, unexpected braking, speeding, and over-idling, among other driving behaviours, using the driving behavior analysis module. Thereafter a feedback can be provided to drivers directly to assist drivers to improve driver behaviour and reduce or avoid accidents.

According to Frotcom (2020) preparing a route is part of any organization's operations. This function assists businesses to track the performance of routes and foresee future events, supporting fleet management methods, reducing fuel usage, and improving productivity. According to Geotab (2021) claims that one of the major costs for fleets is fuel. Fleet managers are concerned about efficient fuel use because fuel expenses take up a significant portion of a company's budget (Frotcom, 2020). Fleets adopting a full fuel coaching and analytics solution centred on driver fuel efficiency behaviours is the most efficient and significant strategy to improve driver fuel efficiency (Geotab, 2021). Knowing how the performance is evaluated and having access to the data helps drivers understand how to change drivers driving habits (Geotab, 2021). This indicates that one of the components within fleet management systems can also assist in monitoring fuel in terms of kilometres accumulated.

Alarms are a useful feature that helps businesses react swiftly to any fleet-related emergency. Using fleet management software, fleet managers can design unique alerts that are tailored to the requirements of the organization. For instance, an alarm can be configured to track speeding, harsh braking, rough turning, or identify accidents. To guarantee that vehicles run economically, it is crucial to stay vigilant to changes (Frotcom, 2020). Hennigan, 2022 stated that maintaining vehicles is one of the most critical aspects of fleet management. Hennigan (2022) reiterated that it is essential for companies to have a regular maintenance schedule to ensure that vehicles are safe and dependable.

A maintenance management system should factor in two key areas, a effective and reactive approach outlined below (Iamshahnewaz, 2022) By regularly checking the condition of vehicles, the probability of Adhoc repairs or breakdowns can be reduced. This helps to minimise the need for emergency expenditures, which can become costly. Preventative maintenance can be conducted annually or according to vehicle mileage while keeping vehicles in good condition (Iamshahnewaz, 2022). Reactive maintenance helps to take care of problems as they arise. A plan to take care of immediate needs allows fixing to be done as needed so that the usual flow of work can be resumed within an abbreviated period. Regular preventative maintenance can help reduce the frequency of emergency maintenance and save money over the long term (Iamshahnewaz**,** 2022).

2.4 Fleet Management in South Africa

According to Research and Markets (2022), there will be 3.6 million active fleet management systems in South Africa by 2026, growing at a CAGR of 12.6% from 2.0 million units in 2021.

Fleet managers can anticipate a growing era for fleet management in South Africa in the next years, according to a market analysis published by (Research and Markets, 2022). By 2026, there are expected to be 3.6 million active FM systems, up from around 2.0 million units at the end of 2021 at a compound annual growth rate (CAGR) of 12.6%. By 2021, it is anticipated that the population's penetration rate of fleet vehicles utilized by enterprises will rise from 41.5 percent.

2.5 Importance of Fleet Management

Fleet management is crucial to fleet managers of eThekwini Municipality to ensure optimum vehicle utilisation and reduce fleet maintenance costs. The eThekwini Municipality monitors its fleet by using various systems [1], a tracking system [2], and Fleet management software [3] onboard vehicle systems. Fleet data collection presents fleet managers with enormous hurdles in terms of successfully and efficiently gathering, storing, and processing fleet performance data stated Bakır (2017). Currently, there are no constructive methods of effective monitoring and managing municipal fleet.

There have been some complaints about the misuse of the municipal fleet, delays in service quality, fuel theft, accidents, bad driving habits and noncompliance which have an impact on the management of the fleet. This has negative implications for fleet management as it is the pivotal

point that is mandatory to monitor municipal fleets. Therefore, there is a need for an effective monitoring method or solution to manage fleet in real-time to improve efficiency in service delivery.

2.6 How Fleet Management is Evolving

According to (Hennigan, 2022) the fleet management business has seen a drastic transformation as a result of technological advancements. The following are some other fleet management trends that Redmer (2016) identified as having potential to improve fleet management procedures: Wireless providers have begun rolling out 5G connection, which offers speeds 100 times faster than those of 4G. The 100 times speeds can significantly increase the bandwidth consumed by fleet management hardware and Internet of Things (IoT) devices by Arya (2022). Military and specialized organization applications use autonomous vehicles. These integrated devices are dependent on various fleet management system methods and may provide special efficiency and safety criteria (Hennigan, 2022). Mobility-as-a- Service may open new possibilities for more affordable use of transportation services, such as rental and public transportation as well as sharing options Avetisyan and Skibniewski (2017). The MaaS schedules are made possible by other significant trends, such as the growth of subscription services and the sharing economy. Telematics assists operators by showing real-time vehicle diagnostics that can improve productivity and decision-making. Competencies become increasingly important as technologies like artificial intelligence (AI) advance and allow for new standards in data collection and visualization (Hennigan, 2022).

2.7 Fleet Management Monitoring

Fleet monitoring is the overall management of a collection of assets that are vital to a business's operations. Fleet monitoring is managing a collection of vehicles and related assets owned and operated by a business. Modern GPS-based fleet monitoring allows for data collection and insight into the use, optimisation, mechanical, financial, and administrative aspects of a business’s vehicles (TitanGPS, 2020). Because every business is different, fleet managers look for different solutions to difficulties and new ways to optimise business. One way to get the most out of business is to implement GPS tracking (TitanGPS, 2020).

TitanGPS (2020) further elaborated that there are three most common reasons that fleet operators invest in fleet management solutions: Many fleet drivers operate independently, taking vehicles home at the end of the day for afterhours utilisation. GPS fleet monitoring systems provide data on engine hours, distance travelled, alerts and trip replay that can assist in categorise authorise and

unauthorised usage of vehicles after hours. GPS fleet monitoring systems equip fleet managers with the tools to recognise, react, and respond to vehicle theft as soon as it happens (TitanGPS, 2020). Fleet fuel management, according to (Geotab, 2020), provides users more control over fuel consumption. Fuel management identifies situations that result in irrational fuel consumption, such as excessive idling or fuel theft. (Geotab, 2020) went on to say that through active management and improved fuel economy, fuel management enables fleet managers to lower the cost of operating the fleet. The following are the components of fleet fuel management:

i Keeping a lookout for driver actions that can reduce fuel efficiency, including as forceful braking, acceleration, and speeding.
ii Gaining more control over when and where gasoline is bought.
iii Improving preventive maintenance plans.
iv Using diagnostic data from the vehicle to do preventive maintenance.
v Right-sizing automobiles for the appropriate duty cycles.
vi Preventing fuel fraud by keeping a lookout on patterns of excessive fuel use (Geotab, 2020).

Aggressive driving, such as speeding, hard braking, and unnecessarily fast acceleration, is hazardous and contributes to premature wear-and-tear of vehicles. GPS fleet monitoring systems have tools that can help combat hazardous driver behaviour by generating reports of personalised driver scorecards, Monnerat et al (2019)

2.8 Aspects of fleet management systems

In any organisation, the task of efficiently managing the utilisation of different transportation means is delegated to a fleet management system (FMS), Kaskatiiski (2020). Numerous organizational projects are underway in many industrialized nations, with businesses implementing cutting-edge technologies like the global positioning system (GPS), fleet management systems, and other wireless ones Begashaw & Temesgen (2018).

GPS fleet management systems may increase fleet efficiency and vehicle utilisation by 10-15% and 15-20%, respectively, and cut fuel consumption by 20-25%, idle time by 20-30%, kilometres travelled by 5-10%, and overtime by 10-15%. This is according to a research report by Peerbits (2022). (Peerbits, 2022) went on to say that GPS-based solutions cut labour costs to just 30 minutes each driver every day. Additionally, GPS car tracking systems do more than only lower costs and improve vehicle performance.

Large-scale firms should use geographical allocation methods to track the distribution of construction equipment, according to Avetisyan and Skibniewski (2017). The advancement of research, according to Avetisyan and Skibniewski (2017), has revealed the importance of using management tools and measurements for a business's success.

2.9 Information and Communications Technology

The management of communications processes such as telecommunications, broadcast media, intelligent building management systems, audio-visual processing and transmission systems, and network-based control and monitoring functions are all handled by information and communications technology (ICT), according to (Techopedia, 2020). Pratt (2022) stated that it includes putting all those different elements into practice. With the advancement of information and communication technology (ICT), users are now able to gather and analyze data on the driver, his driving habits, the vehicle, and the road (Chaba, 2021).

2.10 Fleet management technologies and real-time fleet monitoring

The automated fleet management systems that constantly track the location of objects or events are known as real-time location systems Rathnayaka et al., (2021). When compared to the traditional single mode of GPRS, the embedded GPS real-time monitoring and alerting system makes up the disadvantage of the large time delay and the uncertainty of the time delay in data transmission Ebinowen & Umaru (2020).

Mobile communication, GPS, GIS, RFID, and embedded real-time system design and implementation technologies are among the enabling technologies that support real-time organizational requirements for real-time visibility on transportation, which is a subsegment of the fleet management visibility, according to Wycislak (2021). The most advanced technologies use satellite tags for continuous real-time tracking.

Because every business is different, fleet managers are looking for a different solution to difficulties and new ways to optimise business. One way to get the most out of business is to implement GPS tracking (TitanGPS, 2020). Kaskatiiski (2020) defined the telematic system as a component or device used for collecting data. Utilizing telematics-based devices enables efficient fleet management, according to Chaba (2021). Chaba (2021) stated that speed, position, and fuel consumption level are

regularly acquired information in the car utilizing telematics systems, while information about the driver includes forceful braking and speeding.

Telematics are technical tools that monitor factors related to driving and driving behavior employed by the driver operator, providing crucial information for risk assessment, according to Chaba (2021). The GPS module made by Mobile Data in South Africa is an illustration of such a device by Chaba (2021)

2.11 How fleet monitoring systems and GPS works.

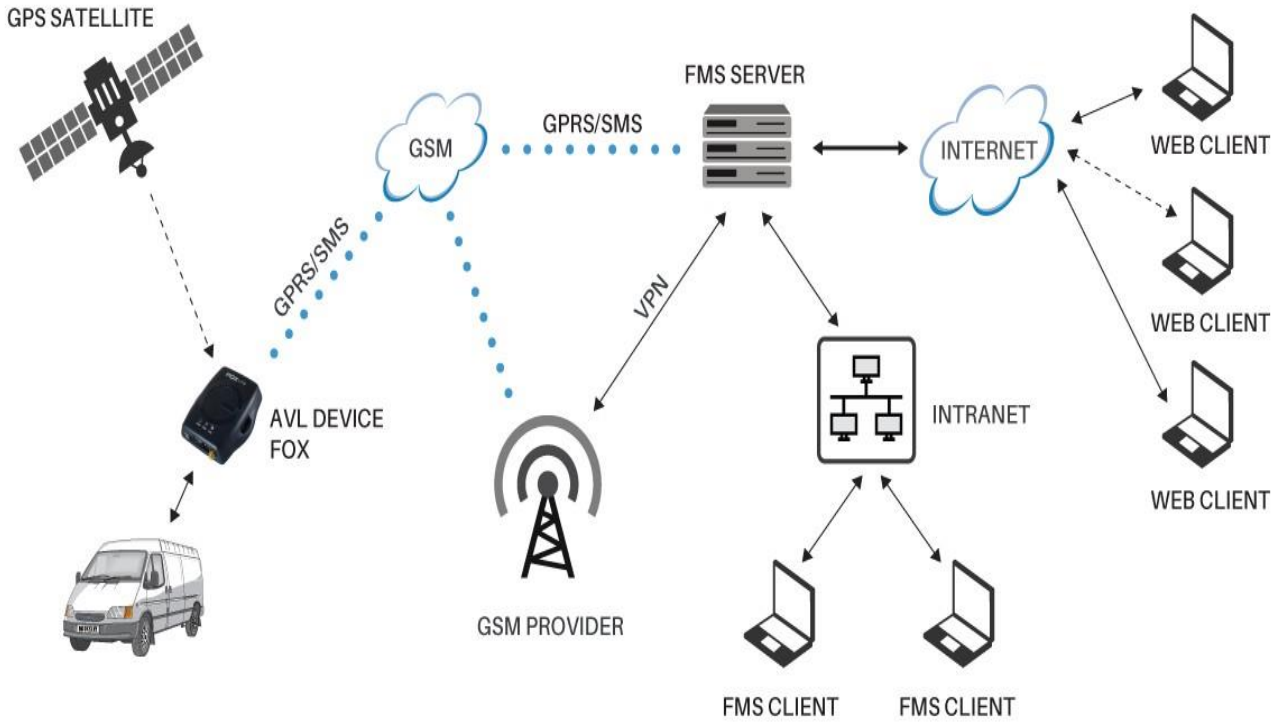


Figure 3: GPS Tracking Model
Source: (GPS Technologies, 2020)

The eThekwini Municipality's vehicles are fitted with a vehicle tracking system which serves as a deterrent to monitor the fleet's movement. The vehicle tracking system is extensively used in the

industry, and most insurance companies do not cover theft or hijacking if the vehicle is not fitted with a tracking device.

According to Ebinowen and Umaru (2020) the fleet management system (FMS) - GPS vehicle tracking system uses a variety of techniques to locate vehicles, including the Global Positioning System (GPS) and other radio navigation systems that operate through satellites and ground-based stations. The trips are thoroughly tracked and recorded using GPS technology. In order to track a car, the technique, according to GPS Technologies (GPS Technologies, 2020), involves plugging a device into the vehicle. To broadcast messages, these gadgets rely on conventional cellular networks (GSM) Pratt (2022).

The tracking devices as a fleet management solution plays a significant role as a deterrent to theft and hijacking, vehicle utilisation, diver behaviour etc. Technology has evolved over the years, and so has the increase in theft and hijacking. The Internet of Things (IoT) platform is a new paradigm growing quickly in the fleet industries. Some IoT applications are smart farming, intelligent transport, innovative health, smart cities, smart homes, and smart grids, Killeen et al. (2019). Big data becomes more prevalent with all devices connected to the internet. According to Killeen et al. (2019) modern data analytics algorithms struggle to process the enormous amounts of data produced by IoT devices.

IoT platform in fleet management allows fleet operators to automate various processes, collect vital data, know refill levels and track daily operations, (Arya , 2022). One of the main factors propelling the market's expansion is the rise in the use of cloud computing systems and the integration of the Internet of Things (IoT) with the transportation sector. Utilizing GPS and IoT for fleet management provides regulatory compliance, improved maintenance, lower costs, and several other advantages (Arya, 2022).

In order to improve decision-making and move toward real-time decisions, (Arya, 2022) asserts that there may be a greater dependence on digital capabilities available for planning and fleet process automation. hence increasing fleet efficiency all around and lowering service delivery expenses.

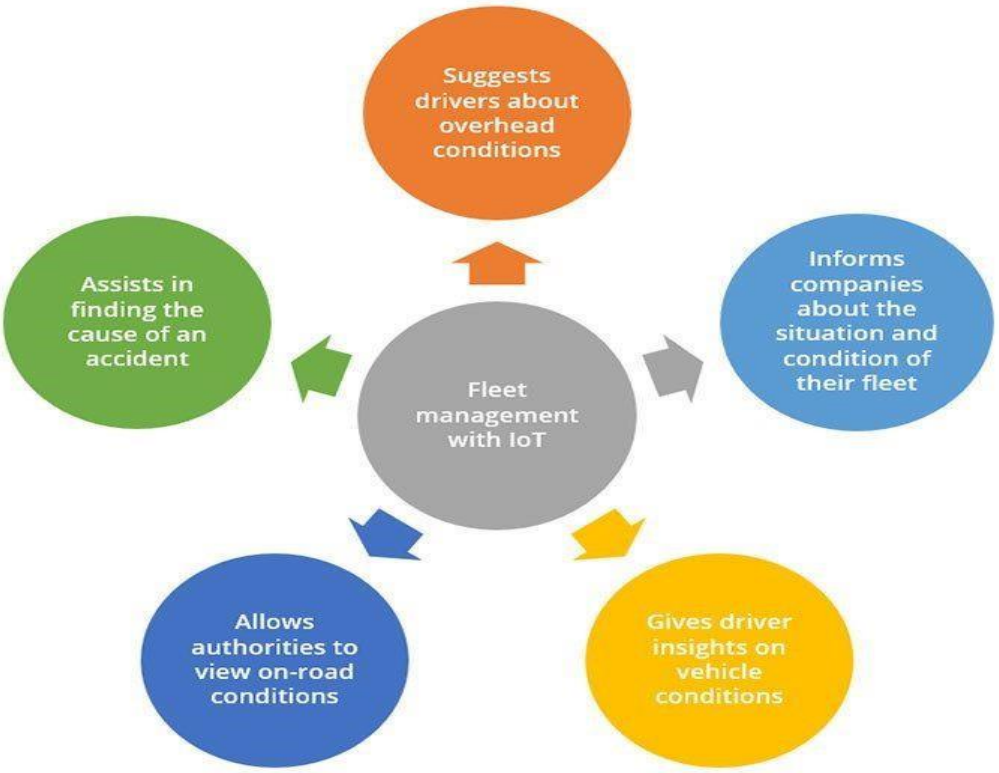


Figure 4: Fleet Management with IoT
Source: (Arya, 2022).

One of the main forces behind business growth is information. Companies rely more and more on data collection, analysis, and insight development. A deeper comprehension of data can aid in the transformation and expansion of enterprises Wilkinson (2021).

According to Wilkinson (2021), vehicle and asset technology advances are likely to continue making more data available for fleet analysis and reports, but only if business intelligence can analyse data effectively. It can help make informed decisions to support a wide range of operational improvements.

2.12 How using GPS and IoT fleet management system improves fleet management.

IoT platform continues to add value to companies worldwide; innovative technologies are changing fleet management and the world of work. Many businesses, particularly fleet managers, find IoT fleet management as a solution for maximising business results (AgileTech, 2020)

(AgileTech, 2020) outlined that IoT technologies allows fleet managers to achieve higher sustainability and corporate responsibility standards beyond operational efficiency. Below are reasons why an IoT platform is important to any organisation:

i Realise the new value of current assets.
ii Increase efficiency.
iii Gain actionable information.
iv Minimise operational costs.
v Create new revenue streams.
vi Prevent theft and unauthorised use.
vii Empower innovation.

2.13 Challenges of fleet monitoring of vehicle utilisation in real time

According to Hennigan (2022), managing the fleet, drivers, expenses, and scheduling presented difficulties for the fleet industry. While removing several obstacles for fleet managers to manage fleet, technology, and software solutions. Efforts to save costs, the unpredictability of fuel prices, and driver safety and productivity are the biggest fleet management challenges. Effective fleet management, according to (Arya, 2022), puts driver safety first. According to (Arya, 2022). businesses may tackle the issue by implementing safety education programs, rules, and predictive analytics to work toward avoiding unnecessary accidents.

Hennigan (2022) stated that costing and forecasts is important to fleet managers to reduce costs. Hennigan (2022) further indicated that it is important for companies to use dependable software and tools that can benefit operational services. Operational cost effectiveness, vehicle maintenance, asset and driver management, vehicle safety and compliance, and operational efficiency are all aspects of fleet management. Reduced fuel costs, optimized routes, increased output, and improved customer satisfaction are all benefits of effective fleet management. Additionally, maintaining driver safety, cutting costs, and projecting fuel prices are issues faced by fleet managers Hennigan (2022).

2.14 Benefits of fleet monitoring of vehicle utilisation in real time

Vehicle tracking offers invaluable benefits to fleet managers, Hardy (2020). By using a fleet tracking system with telematics, you get unparalleled access and insight into your entire fleet. The ability to

track every fleet vehicle is only one of the benefits you will get when you implement a GPS fleet tracking system (Peerbits, 2022: 3).

The fleet GPS and IoT devices collect data from different sensors, interfaces, and systems, thereby creating real-time exceptions and insights. According to Wycislak (2021) combining data from telematics systems, resource planning systems, and transport management systems is necessary for real-time visibility The eThekwini Municipality can achieve its varied objectives with the help of these anomalies and insights. Several of the points include:

i. Optimising Fleet performance
ii. Real-Time Utilisation Analysis
iii. Correcting Driver Behaviour
iv. Reduction in idling and speeding
v. Adherence to compliance
vi. Real-Time interventions to onboard ECU alerts and warnings.

The automated fleet GPS and IoT platform can assist eThekwini Municipality in identifying potential problems sooner. Identifying the problems sooner allows eThekwini Municipality to mitigate the risks before it reaches manageable limits, thereby reducing maintenance costs and improving vehicle availability. Improving vehicle availability improves service delivery. Fleet vehicles and assets such as trailers, generators, tools, and other equipment are costly, Hardy (2020). (GPS Technologies, 2020) indicated that if misplaced or stolen, can cost both time and real money. Keeping assets secure at all times can be challenging.

According to Hardy (2020) stated that having access to the data enables organizations to make better educated business decisions, which lowers operational expenses. Hardy (2020) further stated that having immediate access to data aids organizations in swiftly identifying issues and ensures that solutions may be implemented to reduce costs that would have been incurred had the issue persisted for a longer period. According to Staff (2021) claimed that wages are the second-most significant expense for transportation companies after fuel expenses. Kebande et. al. (2021) went on to say that fleet industries can understand when and how vehicles are being used with GPS tracking. Speeding and other negligent driving practices, like abrupt acceleration, can reduce fuel efficiency and raise costs. Fuel expenditures can be greatly increased by unauthorized vehicle use. Through time-of use limitations and calendar templates, a GPS tracking system can notify management of unauthorized use, Staff (2021).

The biggest concerns for eThekwini Municipality are the misuse of vehicles, driver behaviour, vehicle utilisation, monitoring of route to ensure that service are brought to the communities. Also, the efficiency of the fleet management systems since doesn't produce data in real time basis. The GPS and IoT platforms can produce real-time alerts and warnings when a vehicle's consumption exceeds the defined parameters.

These parameters would be defined based on vehicle type and operational environment. The platform can also be configured via a fuel sensor to provide real-time alerts when a vehicle is not in use, but fuel is being consumed. Companies can use GPS and IoT platforms to improve fleet's utilisation. You can track and monitor drivers and vehicles, time spent in specific locations, and routes taken to see if your resources are being over-or under-utilise, Hardy (2020). Utilizing resources as efficiently as possible, the fleet GPS Tracking merges vehicle sensors, interfaces, and systems onto a single platform, Kebande et. al. (2021). This gives the fleet a real-time perspective. To make wise judgments and fleet improvements, the eThekwini Municipality is concerned with gathering, understanding, and sharing data fast. It can reduce a car's excessive wear and tear by, for instance, minimizing the amount of time it spends idling and over speeding.

Operating fleets is more complex than ever, given the issues facing the industries, such as additional government regulations, driver retention, and driver shortages, to name a few. Fortunately for fleet operators, operational complexity can be overcome with suitable investments in technology Hardy (2020). Driver management software ensures driver safety, improve fleet efficiency, and keep drivers happy Hardy (2020). Implementing a driver management system allows companies to get a comprehensive look at drivers, productivity, and the safety of the businesses assets (Flowers, 2019). A driver management system can automatically upload vital information for businesses fleets, such as fuel usage and telematics data. Fleet managers can receive real-time data on your drivers and assets and identify areas to improve (Flowers, 2019).

A fleet monitoring system and the global positioning system both help to ensure the safety of drivers while they are on the road. For route allocation, autonomous transit routes, real-time tracking, and arrival time prediction, several monitoring techniques are combined with Google Maps in the fleet management system, according to Ebinowen & Umaru (2020). With the implementation of effective monitoring systems within the fleet organisations, fleet managers can be assured of the enhanced safety measures brought about by the system.

An engine's health is important for a vehicle's overall performance. The remote monitoring and diagnostics features of GPS and IoT platforms can assist eThekwini Municipality in monitoring and analysing the engine's critical parts. A fleet's overall efficiency depends on the vehicles' performance. The platform can assist eThekwini Municipality to better insight into vehicles ECU. When a vehicle's components are on the verge of failure or require maintenance, automatic numerous sensors mounted to the vehicle provide warning alerts and signals. The platform ensures that you receive these alerts from the vehicle sensors and ECU interfaces. Alerts such as vehicle temperature, low battery, onboard service reminders, engine faults, etc., are essential for the maintenance of these vehicles. These real-time alerts will allow for immediate intervention by eThekwini Municipality, thus ensuring the vehicles are kept safe and operational and minimising the potential damage to the vehicles and theft. The eThekwini Municipality uses data from the vehicle monitoring system to track how the fleet vehicles are used. The process for deciding non-utilisation, under-utilisation, and over-utilisation based on operational requirements and criteria is not active and this is constructed "after the effect."

The fleet monitoring system, sensors, and interface data are collected by the GPS and IoT platforms, which then compare them to established parameters for each operational department. Then, users of the eThekwini Municipality fleet management systems instantly identify the vehicles that are available, unutilized, underutilized, and overutilized.

Vehicles are one of the "tools" required by user departments to maintain infrastructure and deliver services. Various sensors, such as mass, flow, and sensitivity sensors, can be fitted to vehicles and infrastructure, i.e., Water Tankers, JoJo Tanks, Tipper Trucks, CSW Compactors, etc. The GPS and IoT platforms can be configured to each department's actual service delivery parameters. The platform will provide real-time alerts for the following:

i. Route Deviations, Actual Route vs Scheduled Route.
ii. Filling of JoJo Tanks, distribution of water.
iii. Actual vs Scheduled Services delivered to an area.
iv. Route Optimisation

The GPS and IoT platform solution can provide the linkage between the services that are delivered and the vehicle, thereby providing live measuring of actual vs scheduled service delivery (Arya, 2022). Every business should be concerned with the safety drivers. Starting with keeping vehicles in good condition, this should also pay attention to observing driver behavior and making sure that safe

driving procedures are being followed (Flowers, 2019). Fleets can utilize this information to build incentive and recognition programs that will reward the best drivers and motivate all other drivers to perform better (Flowers, 2019). A company places a high focus on driver and vehicle safety.

2.15 Conclusion

This chapter discusses various existing techniques of fleet management systems, vehicle utilisation, Fleet management with IoT, GPS tracking, driver management, and route management. The study of various information and communication technologies, telematics and GPS tracking, and fleet monitoring solutions were also outlined. Different authors outline the methods and importance of fleet monitoring and fleet management systems.

The following chapter discusses the research methodology.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter describes, explains, and discusses the research design, data collection methods, the research instrument, and the data analysis techniques. It also addresses the concept of validity and reliability. The strategies of research methods to handle the case study and problem statement are covered in this chapter 2. The research methodology will address the research problem through an empirical investigation using a questionnaire. The research approach also focuses on description of the research design, research methods, target population, sampling method, research paradigm, and data collection that addresses the study objective. The research methodology also defines research techniques, reviews research inadequacies, research findings and recommendations in chapter 5 draws conclusions in chapter 6 and from the data collected in chapter 4.

3.2 Research Paradigms and Philosophy

According to Krishnasamy (2022) a research paradigm—a manner of conceptualizing and doing research determines the research philosophy The researcher's particular perspective or stance on the paradigms provide the philosophical, theoretical, instrumental, and methodological underpinnings. There are several paradigms for research philosophy, as shown by the research philosophies in table 3.1, although positivism and interpretivism are the two that are most common. All study has a philosophical worldview at its core.

The interpretivism or phenomenological research paradigm was selected for this study with the interest to embark on an in-depth exploration of effective monitoring technology advancements challenges faced in eThekwini municipalities fleet management systems. Epistemological philosophy, also known as qualitative research, was used for this study to evaluate the efficiency of fleet management systems and its impact on effective monitoring vehicle utilisation within eThekwini municipality. The qualitative research method was chosen for the study because the method aligns with the thematic analysis and the data collection method (interview) which was used during the study.

Table 1: Comparison of Five Key Research Philosophies

Paradigm: The hypothetical and methodological assumptions	**Ontology:** nature and concepts categorie	**Epistemology:** how knowledge is created and acceptable	**Axiology:** ethical issues that needs to be considered	**Research methods**: strategies and processes use to collect data
Positivism Saunders et al. (2019)	One that can be understood, identified, and measured	Scientific approach verifiable and quantifiable facts	Separated, impartial, and independent researchers maintain research	Survey, experiment, quasi-experiment
Interpretivism Saunders et al. (2019)	Philosophy and languages are social constructions that give rise to different meanings, interpretations, processes, experiences, and practices.	Simplicity in theories and notions places a strong emphasis on stories, perceptions, and interpretations.	Value add research Researcher s are part of research study, interpretations key to contribution.	Inductive. small sample sizes, thorough research, qualitative analytic techniques (Case studies, interviews, ethnography)
Critical realism Saunders et al. (2019)	Stratified random sampling, Intransient Objective, structures Causal mechanism	Causal explanation as a contribution, knowledge-based creation that is historically situated	Beneficial research, The researcher acknowledges worldview bias, cultural knowledge and minimizing researcher bias	Investigation of existing information from a historical perspective, using a variety of techniques and data formats to fit the case study
Postmodernism Saunders et al. (2019)	Individuals' and experiences behaviours, interpretations, and realities	Exposing power dynamics and contesting dominant ideas are contributions	At the expense of other research narratives, some are suppressed and silenced	A variety of data formats, qualitative analysis techniques
Pragmatism Saunders et al. (2019)	Numerous procedures, encounters, and routines	The application of knowledge in particular settings, problem-solving techniques and future practice that is informed as a contribution	Centred on values research started and maintained by the researcher's uncertainties and convictions	A variety of techniques are used, including mixed, multiple, qualitative, quantitative, action research, emphasis on useful outcomes and solutions

Source: (Adapted from Saunders et al. (2019)

3.3 Rationale of Research Design and Methodology

A case study is the examination of the particularity and complexity of a case, coming to understand its activities and particular circumstances, Stake (1995). Yin (2017) outlines case studies critical features. Case studies investigate a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident, Yin (2017). The phenomenon and its context are intertwined, but the case should represent a bounded system, in which the case is clearly defined and delimited, Merriam and Tisdell (2015). Several research topics and questions indicate a case study as an appropriate approach.

The key criterion is the bounded system, so any research situation where the bounded system is central is a candidate for case study. A case study can be a complete research project, such as in the study of a particular organization, community, or program. Case studies are also often used for evaluation purposes, for example, in an internal and external review. In educational contexts, case studies can be used to illustrate, test, or extend a theory, or assist other organisations to analyze or shape practices. For example, Nogueiras, Iborra, and Kunnen (2019) used a case study to investigate the process of transformative learning for students in a counselling master's degree program.

The qualitative research method was selected to evaluate the effective monitoring of vehicle utilisation using eThekwini Municipality fleet management systems. In the empirical study, the researcher used a qualitative method to evaluate the effective monitoring of vehicle utilisation functioning and productivity of the eThekwini municipality's fleet management system. The case study research method was applied to this study as the best approach to analyse actual situations Saunders et al (2019).

3.4 Research Design

Research design is the program that guides the researcher in the process of collecting, analyzing and interpreting data and information. The study design is a structure that outlines the factors that were considered when choosing the right methodology, how respondents were chosen, and how the data would be analyzed Sileyew (2019). The research design is the strategy for integrating conceptual research concerns with pertinent and doable empirical research, Luck (2019). According to Jilcha (2020), the research design establishes the information gathering and analysis techniques as well as

how the process responds to the research topic. The strengths of a good research design are evident in research works utilizing randomness, Angrist and Pischke (2010).

A qualitative case study examines a phenomenon within its real-life context. Data are collected on or about a single individual, group, or event. In some cases, several cases or events may be studied. The main purpose of this type of research is to understand the problem in-depth. The primary purpose of a case study is to understand something that is unique to the case(s), Yin (2017). Knowledge from the study is then used to apply to other cases and contexts. According to Leavy (2017), qualitative case study methods often involve several in-depth interviews over a period with each case, Yin (2017) indicated that interviews explore the unique aspects of the case in detail.

The researcher collected data in two ways, mainly thematic content analysis and structured interviews as illustrated in Figure 3.1. These qualitative research methods which are highlighted in section 3.9.

Figure 5: Data collection method
Source: Saunders, Lewis, and Thornhill (2019)

This study uses qualitative cases study design to gain an insightful understanding and richer contextualisation of the phenomenon being researched. The study selected a sample of individuals who are the super users of the fleet management systems within eThekwini municipality department of City Fleet.

3.5 Research Methodology

To achieve its objectives, the study used qualitative and quantitative approaches with primary and secondary sources. The superior design to achieve its objectives, the study used qualitative and quantitative approaches with primary and secondary sources. The analysis and findings of the quantitative data are supported by the qualitative data. Since the researcher used both qualitative and quantitative data types in the data analysis, the outcome is triangulated.

Research methodology, according to Batallán (2019), is a set of guiding principles and presumptions regarding the growth of knowledge. Analyzing assumptions, guiding concepts, and investigative methods are all part of this process. According to Batallán (2019), the research methodology is founded on a certain philosophical theory that suggests research tactics and methodologies.

The methodology outlines the general approach to conducting research and how it should be done. It contains a set of values and philosophical presumptions that set forth how the research questions are to be understood and underpin the research methodologies that have been selected. A dissertation or thesis must include a research approach to help guarantee that the methods, tools, and underlying philosophy are all consistent (Bullock, 2022)

One method of developing a research methodology is based on the theoretical "Research Onion" figure 3.2 idea put forth by Saunders et al. (2019). The major steps or layers that need to be completed to create an effective technique are described by the research onion Saunders et al. (2019).

Beginning with the core concept, selecting methodologies, methods, and tactics, and establishing time horizons, the research methodology moves on to the study design, which includes the primary tools and procedures for gathering and analyzing data. Research methodology, according to Saunders et al (2019), is a research plan that specifies the steps involved in conducting research and how it should be done.

Research onion concepts provide a solid foundation for building an intelligible and practical research design, according to Alturki (2021). Bullock (2022) asserts that using the research onion model as a

framework, a suitable research methodology can be developed step-by-step. As a result, it might serve as the main model for academic study.

Following the identification of the research problem or a topic of interest, the study must determine how to approach the problem, as was said under the assessment of the many definitions of study. Starting with the fundamental concept, selecting methodologies, methods, and strategies, and establishing time horizons, the research methodology leads to the study design, which is represented by the main techniques and procedures of data collecting and analysis in Figure 3. 2. The research onion was separated into three choices by Saunders et al. (2019). The first two outer rings, which are the research philosophy and research approach. The research design, which is the inner core of the research onion and consists of data collection and analysis.

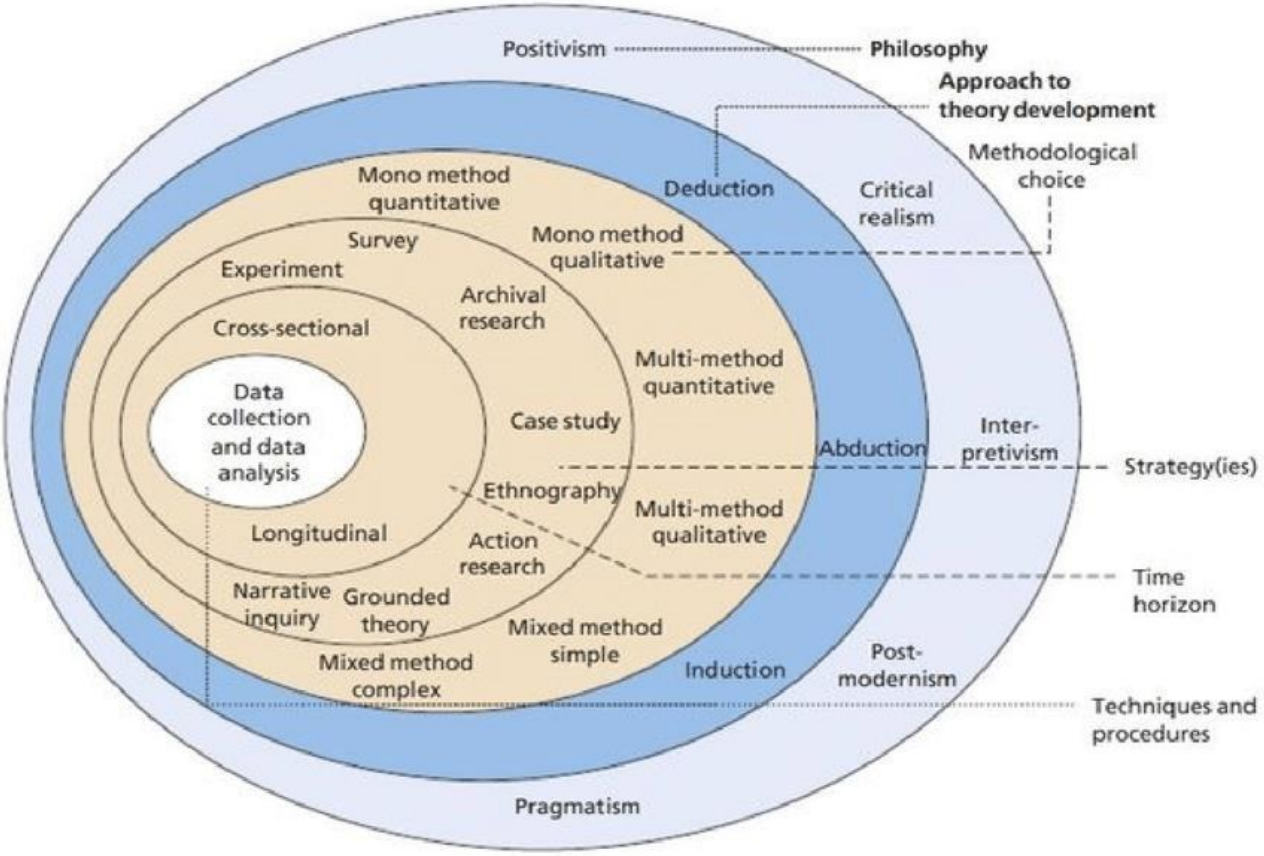


Figure 6: Research Onion
Source: Saunders et al. (2019)

3.6 Research approach

According to Creswell (2014), research approaches are understood as plans and procedures for research that reduce expansive assumptions to more detailed methods of data collection, analysis, and interpretation. The roots of qualitative research can be found in languages, semiotics, history, philosophy, psychology, and anthropology. Mohajan (2018) explained a primary goal of qualitative research methodology as to describe and evaluate data in a systematic manner. Additionally, Mohajan (2018) indicated that it has been observed to be receiving more attention from academic environmental institutes at the same time.

According to Ashley (2019), qualitative research is set up to reveal the meaning that influences people's behavior and interactions with others. According to Creswell (2018), an explanatory research paradigm that depicts a world in which certainty is socially produced as a social construct typically supports qualitative methods. Denzin and Lincoln, (2011) stated that qualitative research draws from interpretivist and constructivist paradigms, pursuing to deeply understand a research subject rather than predict results, as in the positivist paradigm.

Interpretivism seeks to build knowledge from understanding individuals' unique viewpoints and the meaning attached to those viewpoints, Creswell and Poth (2018). Constructivism views knowledge as constructed as people work to make sense of their experience Creswell and Poth (2018). In whole, qualitative research values people's lived experiences and is inherently subjective and sensitive to the biases of both researchers and participants.

Instead of using a quantitative strategy, the researcher in this study chose to utilize a qualitative approach because it was helpful to learn about participants' varied viewpoints and experiences and to monitor behavior and attitudes during interviews. Qualitative research, conducted thoughtfully, is internally consistent, rigorous, and helps to answer important questions about participants perceptions in relation to the study, Lincoln and Guba (1985).

Table 2: Differences of Qualitative and Quantitative Research

Qualitative	Quantitative
Information obtained through interviews with chosen groups, case studies, specialized opinions, and observation	Information gleaned via polls, surveys, and other methods
Using "human touch" to discover and investigate a problem. (e.g., a customer complaint)	Use of closed ended (yes/no) and multiple-choice questions
Assist to formulate a theory to be researched	Unable to use a "human touch" to interpret people's perception
Field results are categorized, summarized, and linguistically interpreted.	Examine and confirms a formulated theory
Results expressed as transcript	Results are analysed mathematically and statistically
Fewer respondents needed	Results expressed as numbers, tables, and graphs
Less suitable for scientific research	Many respondents needed
Harder to duplicate	Results are appropriate for scientific study because they work with common statistical analysis techniques
Harder to duplicate	Easy to duplicate
Less suitable for sensitive data: respondents may be biased, too familiar or inclined to leak information	Ideal for sensitive data as it can be anonymised and secured

Source: (adapted from Creswell, 2018)

3.7 Target Population

Eisend (2019) defined the term target population as a certain set of people with comparable traits who are identified as the target market for a product, advertisement, or research. A subset of the participants chosen as the objective audience is the target population. Five users of the FMS for the eThekwini Municipality made up the target population. The sample frame is modest (5 potential participants); hence the criteria are based on employment history inside the company over a longer period. According to Eisend (2019), the target population is the entire group of participants who meet the sampling criteria. Given that the sample frame is small 5 possible participant, the population comprises members or collective of individuals, who meet specific criteria required for this study.

3.8 Sampling method

The term sample refers to a group of individuals chosen to represent all possible scenarios. States selected for sample ought to be relevant and reasonable (Batallán, 2019). Purposive sampling was the sampling method employed to meet the objectives of the research. This type of sampling enabled the researcher to focus on specific characteristics of the population and thereby fulfil the study's aims and objectives which is to evaluate the effective monitoring of vehicle utilisation at eThekwini municipality. According to Saunders et al. (2019) the sample size in qualitative research is relatively small, which is determined by theoretical saturation. Anon (2022) indicated that the scale of sample size facilitates the detailed exploration of each sample and maximizes the usefulness of the data collected. Two types of sampling procedures are Probability Sampling and Non-Probability Sampling.

3.8.1 Probability Sampling

In the probability sampling technique, a researcher selects a few criteria and randomly selects individuals of a population. According to (McCombes, 2022) any member of a population with a high degree of homogeneity is quite likely to be chosen for a sample. Most often, it is utilized in quantitative research (McCombes, 2022). With this selection value, every participant has an equal chance to take part in the sample (McCombes, 2022). Stratified, cluster, and simple random sampling are all types of probability sampling techniques.

The simplest type of probability sampling is simple random sampling, which involves choosing research sample participants at random from the population of interest. In the probability sampling technique known as systematic sampling, participants in the research population are chosen at random beginning points and fixed intervals. The concept of societal stratification is the foundation of stratified sampling. When the studied population is divided into subgroups (strata) based on gender, age, income levels, and other comparable criteria, stratification takes place. A weight corresponding to each stratum's size is assigned. In each stratum, a random beginning point is then chosen before a sample is drawn (Anello, 2021).

3.8.2 When to Use Probability Sampling

Anello (2021) asserts that probability sampling is most effective in quantitative research, particularly when addressing a sizable population of interest. The primary goal of quantitative research is to collect and analyze numerical datasets, or data that can be counted. Probability sampling is used in this situation to assist businesses in obtaining findings that fully represent the research population (Anello, 2021).

3.8.3 Advantages of Probability Sampling

i. Probability sampling lessens the likelihood that your research population will be impacted by systematic errors and sample bias.
ii. Because the sample population and study population are quite similar, researchers can utilize findings to draw reliable conclusions about the population of interest.
iii. Probability sampling is simple to use and does not require any technical or specialized skills, making it a cost-effective data gathering technique that helps the researcher save time.
iv. Probability sampling delivers extremely dependable data (Anello, 2021).

3.8.4 Disadvantages of Probability Sampling

Below are some limitations of probability sampling in research.

i. When working with a huge population, it can take time.
ii. Despite randomization, the researcher can select comparable research variables, which lowers the quality of the results (Anello, 2021).

Table 3: Difference between probability sampling and non-probability sampling methods

	Probability Sampling Methods	**Non-Probability Sampling Methods**
Definition	The sampling technique known as probability sampling selects samples from a larger population through a methodology based on the idea of probability	Non-probability sampling is a sampling technique where the researcher chooses samples based on the personal preferences as opposed to randomly
Alternatively Known as	Random sampling method.	Non-random sampling method
Population selection	Population is chosen at randomly	Population is selected arbitrarily.
Nature	The research is conclusive.	The research is exploratory.
Sample	The sample chosen uses a process, so the population's demographics are reflected.	The portrayal of the population's demographics is typically skewed because the sampling methodology is random.
Time Taken	Takes longer to complete because the selection criteria are defined by the research design before the market research study starts.	Since neither the sample nor the sample's selection criteria are ambiguous, this kind of sampling technique is rapid.
Results	Because of the complete objectivity of this form of sampling, the findings are both conclusive and objective.	The results of this form of sampling are completely biased, making the research questionable.

Source: (Anello, 2021)

The table above reflects the difference between probability sampling and non-probability sampling methods.

3.8.5 Non-Probability Sampling

Non-probability sampling is a sample selection technique that use non-random methods to choose a group of participants for a study (Anon, 2022). Non-probability sampling makes use of a suitable selection of population units and relies on subjective judgment. Non-probability sampling would produce superior outcomes in some studies (Anon, 2022).

For in-person interview surveys, non-probability sampling techniques result in cost savings, with samples that resemble probability sample data frequently. When the likelihood of choosing items is unknown and statistical inference is not necessary to determine the responses to research questions, the non-probability method is utilized (Anon, 2022). The following sample techniques are non-probability sampling techniques:

Sampling at the researchers' convenience is preferred, according to Anon (2022). To acquire trustworthy information, the researcher chooses participants from the research subject region. In convenience sampling, the researcher chooses from among participants who are easily reachable or available (Anon, 2022). According to Eisend (2019), purposive sampling chooses examples with a specified goal by using an expert's judgment. Samples taken just for research related purposes are less expensive, easier to get, and more practical.

Eisend (2019) went on to say that there is no way to guarantee that the sample is representative of the population, therefore the emphasis is more on the researcher's capacity to evaluate the population's constituent parts. Uncontrolled quota sampling and controlled quota sampling are two variations of the procedure known as quota sampling (Anon, 2022). In uncontrolled quota sampling, the researcher chooses accessible individuals.

To gather information from participants, a non-statistical sampling technique was used. A questionnaire guide was created and sent to participants through email at the same time as face-to face interviews. Since the non-probability sampling approach does not involve statistics, it was used to satisfy the research objectives and provide answers to the research questions. By using this strategy, the researcher will be able to pick participants at random who have expertise in fleet management and who are also power users of the fleet management system.

3.9 The eThekwini Municipality Case Site

Yin (2017) mentioned that a case study investigates a contemporary phenomenon. However, a simple narrative discussion does not make case study research. The phenomenon examined should be of theoretical significance by Merriam and Tisdell (2015). (Creswell and Poth, 2018) also mentioned that a theoretical framework is regarded as essential for any case study. Yin (2017) argued that the use of theory is an immense aid in defining the appropriate research design and data collection. He further argued that the same theoretical orientation also becomes the main vehicle for generalizing the results of the case study. (Merriam and Tisdell, 2015) observed that in general, understandings were developed illustrating the relevance of particular social theories and by their application to specific case studies.

Case studies rely on theoretical inference for the generalisability of their findings. To make it general, case study findings should relate theoretically relevant characteristics reflected in the case to one another in a logically coherent way (Silverman, 2020). Theoretical generalization is, therefore, possible instead of statistical generalization in case studies. As Luck (2019) noted theories are rhetorical devices for both interpreting case studies and convincing the research community as to the validity of the case findings and interpretations.

The researcher selected eThekwini Municipality as the organisation of the study. The study aimed to evaluate the effective monitoring of vehicle utilisation monitoring using fleet management systems to monitor service delivery within eThekwini Municipality boundaries. eThekwini Municipality department of City Fleet manages and maintains approximately 8000 vehicles. eThekwini City Fleet has identified some of the "use cases" for the Fleet Management Systems.

The determination for these cases is:

i. To achieve value for money by optimising the use of vehicles.
ii. Use the vehicle tracking data to identify gaps in service delivery and enhance service delivery.
iii. Use vehicle utilisation data and service delivery demands to right-size the fleet.
iv. Improve driver performance and behavioural patterns to minimise vehicle operating costs.

Interviews were conducted using a questionnaire guide designed by the researcher. Respondents' opinions concerning the effective monitoring of vehicle utilisation using fleet management systems and its impact on service delivery within eThekwini were captured.

3.10 Data collection

According to Fetters et al. (2019), data collecting is a technique that enables the gathering of study findings. When conducting a case study, researchers use a variety of data collection procedures. Merriam and Tisdell (2015) and Creswell and Poth (2018) suggested multiple information sources for reconstructing and analyzing the case. To conduct the study, secondary and primary data sources were explored. Primary data are facts or information acquired directly from participants as semi structured in-depth interviews were conducted to gather information from the respondents. Documents, information, and data from earlier studies, including published official reports and documents from the named entities, journals, and other empirical studies in the field, were used as secondary data in this study.

3.10.1 Data collection instrument

An interview in a qualitative study needs to have multiple characteristics, Creswell (2018). Multiple social science scholars have reiterated the importance of interviews as a tool for data collection in qualitative studies, (Barrett and Twycross, 2018). Interviews can be categorized as structured, semi-structured, and unstructured, (Neergaard and Leitch, 2015), and choosing the right type of interview is critical in qualitative research.

In-depth interviews were used by the researcher to delve beneath the surface. Open-ended questions allowed the respondent to participate in the subject freely and interactively in a semi-structured manner. This allowed flexibility, the expression of self and a clarification of questions from the participant.

3.10.2 Interviews

Interviews can be structured, semi-structured, and unstructured. The structured interview format compels the researcher to use precisely the same questions with all participants, while the semi-structured interview format allows the researcher to add or omit any aspect of the pre-planned questions, Creswell (2014). The semi-structured interview consists of several key questions that help to define the areas that are being explored in the research. The researcher tends to use semi-structured interviews to enable the interviewee to elaborate on certain issues, Saunders et al. (2019). Conversely,

unstructured interviews require no question guide. Generally, interviewing is considered as the most popular qualitative View metadata, citation and similar academic studys and journals.

During the interview process the researcher assumes that the meaning research participants assign to their experiences is filtered through context and interpreted according to experience and biases (Rubin and Rubin, 2012). In other words, it is assumed that all humans take in and make sense of their world by drawing on what they know and what have experienced in the past. The act of recalling and reconstructing what occurred, and then sharing the experience during the interview, provides the research participant with the opportunity to reflect on what that occurrence meant and choose which aspects are important within the experience Yin (2017), and provides the researcher with the opportunity to understand another's perspective, (Saunders et al., 2019) as well as the context within which it occurred (Denzin and Lincoln, 2011) Researchers also assume that the research participant's interpretation of their experience can change and be altered by subsequent knowledge, including what occurs within the interview (Rubin and Rubin, 2012).

The purpose and objectives of the study served as a reference for the interview questions that were designed for the participants. The research guide was divided into two sections by the researcher. Each participant's interview lasted 30 to 60 minutes. The researcher was able to analyze the perspectives of the participants since the interviews were frank and open-ended. The researcher employed certain questioning approaches to better grasp their perspectives and experiences as well as to seek clarification. Structured interviews, according to Yin (2017), heavily rely on the use of probes.

3.10.2 Participants' Coding – Interviews

Table 4: Participants' Coding

PARTICIPANT	*CODING
Interview 1	*P1*
Interview 2	*P2*
Interview 3	*P3*
Interview 4	*P4*
Interview 5	*P5*

3.11 Protocols

According to Mohajan (2018). construction research instrument is the method of constructing research instruments used appropriately in gathering data on the study. According to Batallán (2019) perceived research instrument as a reliable, consistent, stable, predictable, and accurate significant method of conducting research. A good research instrument has been validated and has proven reliability.

The data used in this study were collected in audio recordings, with the authorisation of participants following transmission in the script. This research aims to identify and evaluate the effective monitoring method of vehicle utilisation using the Fleet Management System of the eThekwini municipality. Through the participation, (the researcher) intended to gather information from the participants and experience in monitoring vehicle utilisation using the Fleet management system.

3.12 Data Analysis

In qualitative inquiry, data collection is not an end. It requires analysis, interpretation, and presentation of findings (Mohajan, 2018). Data analysis is the process of bringing order, structure, and meaning to the mass of collected data (Batallán, 2019). Yin (2017) mentioned that qualitative data analysis requires some steps, (Yin, 2017) further outline the steps as organizing the data; immersion in the data, generating categories and themes, coding the data, writing analytic memos, offering interpretations, searching for alternative understandings, and writing the report or representing the inquiry.

The purpose of the phenomenological technique is to explain a phenomenon by the individuals who experienced it, thus while analyzing the data, it is important to pay attention to what participants stated when describing the phenomenon (Rubin and Rubin, 2012). Two strategies exist for doing this. One method is to apply the phenomenological analysis described by Creswell and Poth (2018). Their analysis adheres to the phenomenological approach's inductive style. They begin their analysis by employing phenomenological reduction to read the whole description that the participants had written; this enables bracketing. The second phase entails carefully reviewing the description to create meaning units (passages that highlight the participants' experience with the phenomenon). Thirdly, researchers need to transform the meaning units into central themes by making what is implicit explicit and making some generalizations. Lastly, the essence of the phenomenon needs to be determined by going over the central themes.

3.12.1 Thematic Analysis

According to Vaismoradi et. al. (2016) stated that qualitative content analysis is also known as thematic analysis, it is a research technique used to identify the existence of specific terms, themes, or concepts in each qualitative data set (i.e., text). Terry (2021) made a statement based on content analysis indicating that researchers could count and analyze certain words, themes, or concepts to determine frequency, meanings, and relationships. For instance, researchers can assess the language used in various articles to look for partiality or bias. Researchers can also draw conclusions about the texts' messages, the author(s), the audience, and even the society and period in which they were written (Terry, 2021).

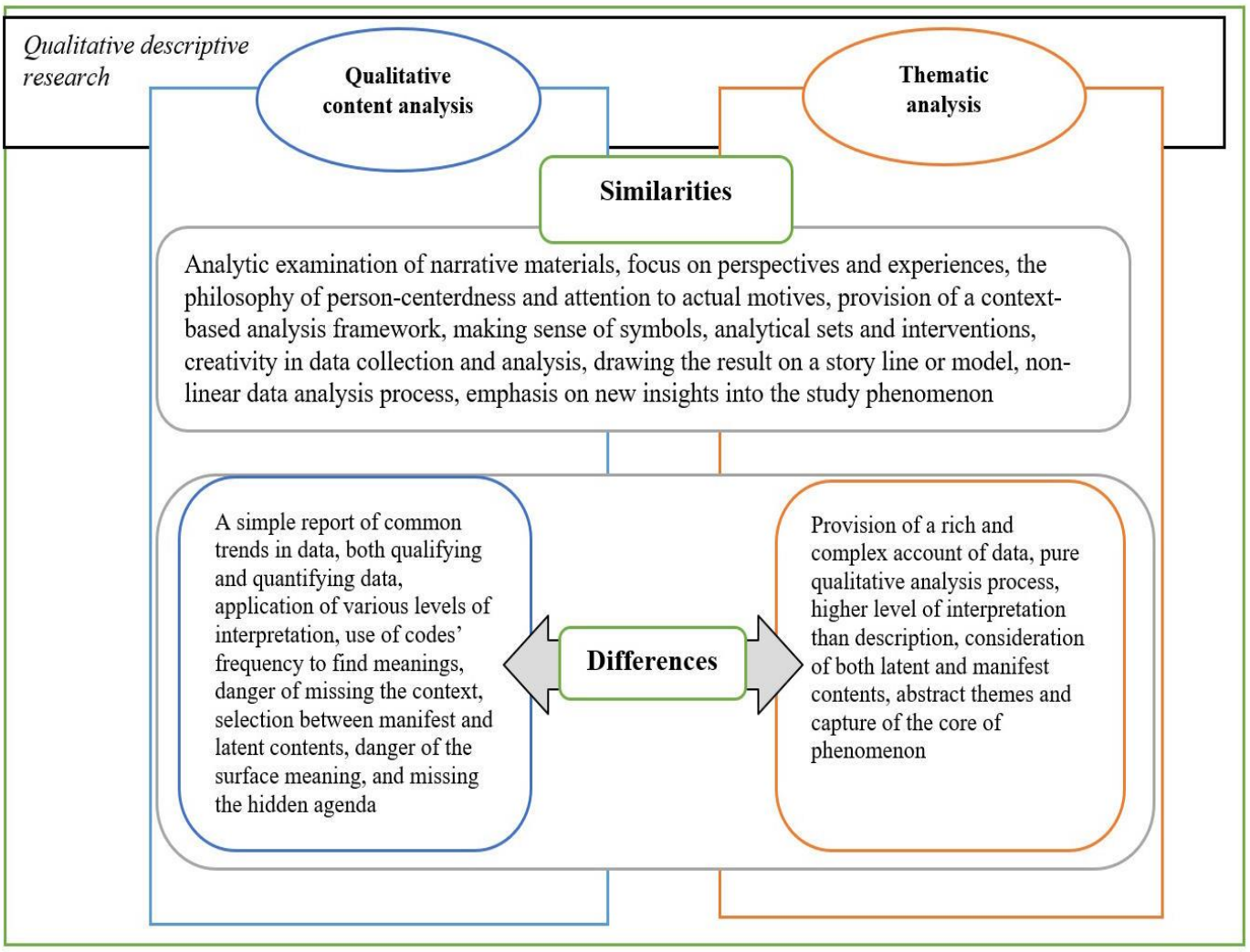


Figure 7: A general overview of the comparison of qualitative content analysis (QCA)
Source: Vaismoradi et. al. (2016)

Data Analysis Methodologies RQ1, RQ2, and RQ3 were addressed by the interview data (see Annexure A). As recommended by Braun and Clarke (2006), the researcher employed thematic analysis to examine the interview data. Six steps were identified in the data analysis process by Braun and Clarke (2006). Getting acquainted with the data is the first phase, which entails reading and rereading all five transcripts of interviews to examine the phenomenon being studied. Creating initial coding is step two. To accomplish this stage, the researcher reduced the amount of data by organizing it in useful and systematic ways.

The third step in the data analysis process includes searching for themes by examining how the codes combined to form overarching themes in the data. Following this step was the organization of codes into a list of themes and broader patterns based on their significance to the research questions. In the fourth step, the researcher reviewed the themes and modified and developed the preliminary themes identified in Step 3. This step focused on ensuring the themes made sense and examining whether they supported or refuted each of the research questions.

The themes were defined in step five, and the final iteration of the themes was produced. The key goals of this step are to identify the overarching themes, what each theme is about, and which components of the data are represented by each topic (Braun & Clarke, 2006). According to Maguire and Delahunt (2017), the researcher looked at what each theme explained, how the themes linked to one another, and how any subthemes related to the primary subject. The sixth and final phase involves choosing the themes that made a significant contribution to addressing the study questions and reporting on those.

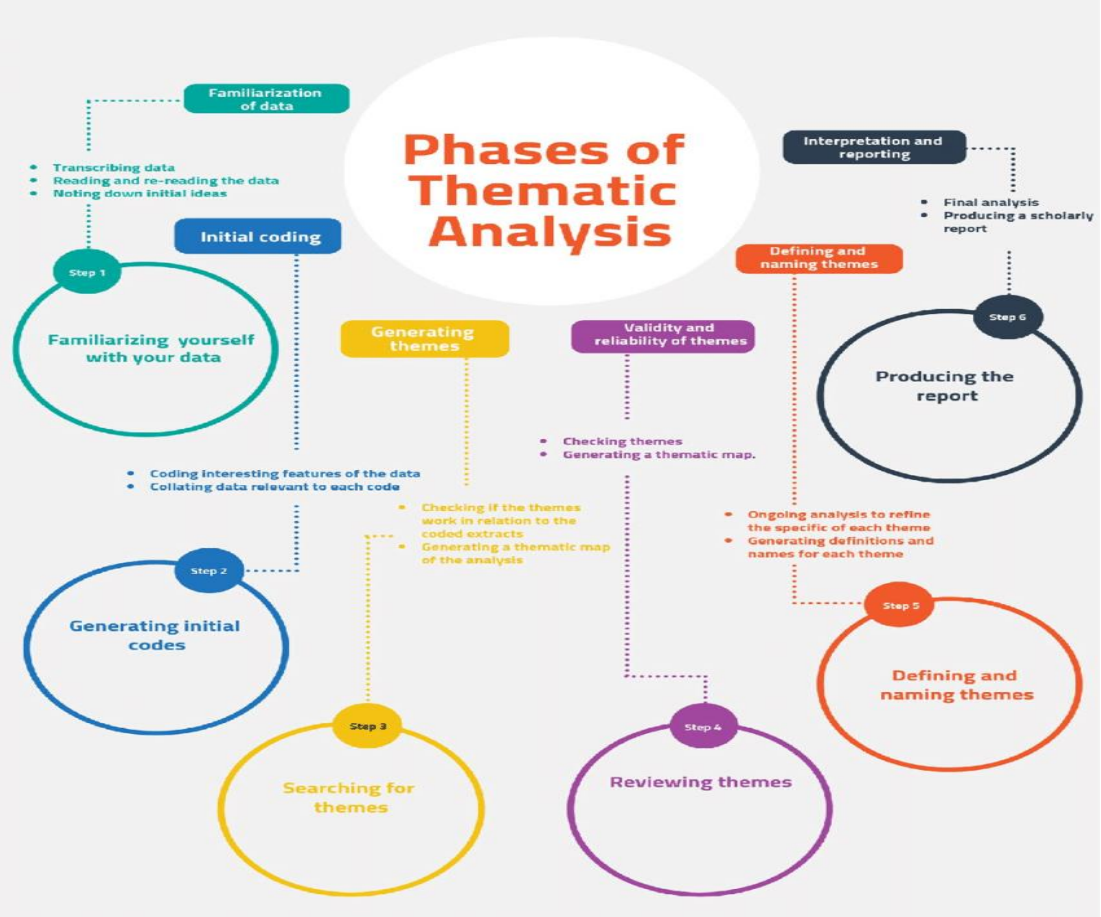


Figure 8: An illustration of Braun and Clarke's thematic analysis approach for developing themes from qualitative data.
Source: Braun & Clarke (2006)

3.13 Reliability and Validity

When an instrument is used repeatedly with the same individuals under the same conditions, it must measure in an identical manner to be considered reliable. According to Mohajan (2018), reliability can be used to explain using a quantitative approach and to foster comprehension using a qualitative approach. According to Creswell (2018), dependability issues can be resolved by detailing the research measurements and instruments used so that other researchers can gather data in a comparable manner.

According to Mohajan (2018), validity is the closest thing to the truth that is currently possible, including theories regarding the cause at best; one can know what hasn't been proven to be incorrect. Researcher and academic alike must therefore treat conclusions that assert validity as approximative

or provisional. If a study measures or analyzes what it promises to measure or examine, it is said to be valid (Mohajan, 2018).

The research tool must consistently measure what it was designed to measure to be considered reliable by Creswell and Creswell (2018). This refers to the degree to which the researcher's method of assessment and the data gathered yield consistent outcomes, Creswell, and Poth (2018). The interview questions were submitted to the supervisor prior to the interview for a go ahead and approval. Given the modest sample size, this was sufficient for pre-testing. To improve the validity and reliability of the interview questions, the following metrics were used:

i All questions were directly linked to the aim and objectives of the study.
ii Each question was formulated using the objective as guidance, fundamentally feeding back to the objectives.

3.14 Limitations

The study sample population was restricted to the City Fleet Unit and the staff departments of the eThekwini Municipality. The study was restricted to personnel that commonly utilize the system as a daily operational core function due to the complexity of the fleet management system.

The eThekwini Municipality fleet management system requires employees that possess specialised skill. This the limiting aspect as the researcher was limited to select employees who are familiar with the system and familiar with the business operation. The researcher selected five employees that utilises the system on daily bases for business continuity, the was unable to employ more participants as employees are alternating as working hours are based on shift work.

The researcher endeavoured that there was no biasness during the literature review, collection of data by sampling participants from various levels of management and different sections or depots and analysis of data. The researcher approaches each process with integrity and objectivity.

3.15 Ethical Consideration

The following ethical issues were considered during the study period in accordance with the laws and guidelines of the research industry about employing human subjects in research. These considerations applied to this study indicated in qualitative research sections. Ethical issues must be considered consistently throughout the research process, from formulating the research topic to

obtaining gatekeepers' letters, obtaining consent from the participants, and ensuring confidentiality during interviews and analysis. Confidentiality and anonymity were also taken into consideration and participants were advised prior to the interviews. Each interviewee received assurances regarding anonymity and consented to the recording of the interviews.

3.16 Permission

Permission was obtained from eThekwini Municipality, Department – City Fleet prior to the commencement of the research.

3.17 Conclusion

The study begins with a brief discussion of the conceptual foundations that guide it followed by a brief introduction to the case study approach. It then provides a background on qualitative methods that have traditionally been used in operations management research. The numerous approaches and procedures pertinent to this research study have been explored in this chapter three. The chapter established the framework for the research's methodological choices. The research approach for this study was described in this chapter. The concept of validity and reliability was further discussed in the chapter, along with how it contributes to the study value and applicability in a variety of research contexts, enterprises, and the field of fleet management and information technology advancements research.

The next chapter provides results, discussions, and interpretation of findings from data analysis.

CHAPTER FOUR: DATA ANALYSIS - PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

In order to improve understanding of the research study, this chapter presents data collecting and analysis techniques and focuses on handling the collected data and its interpretation in a concise and comprehensible manner. This chapter presents the discussions on the data in the form of results and findings using both primary and secondary tools. Interviews were the primary tool used to collect data from participants. The participants were invited via MS Teams and electronic appointments were scheduled according to the participants availability as well as in terms of abiding by government regulations. Data collected from participants was analysed using NVivo software.

The data collected is in relation to the study's aim and objectives. The objectives of the study are supported by the research questions, which aimed to tackle the study's objectives and provide substance to them. The study findings are also presented in this chapter. It also describes any potential difficulties and any noteworthy benefits of the effective monitoring of vehicle utilisation and efficiency of the fleet management systems to improve service delivery to the eThekwini communities. The extensive results from the qualitative data are now provided considering the goals stated in Chapter one, namely:

- To evaluate effective monitoring of vehicle utilisation eThekwini Municipality's fleet management system in Durban.
- To explore the root causes of challenges experienced during the monitoring of vehicle utilisation using eThekwini Municipality FMS.
- To make recommendations on FMS framework to improve effective monitoring of vehicle utilisation on real time basis.

The results yielded by the qualitative data analysis were presented in the form of the key themes that emerged, along with relevant sub-themes that add rigour and robustness to the findings. Various relevant diagrams and pictures are included to emphasise the findings of the qualitative data analysis.

4.2 Participants

The research adopted a qualitative research approach and used a purposive sampling technique to select participants. The study selected eight (8) participants and given that the small sample frame, the criteria was based on the scope of work, knowledge, and the functionality of fleet management systems and within the organisation over a longer period. The eight (8) participants were invited and available to be interviewed.

4.3 Data analysis

4.3.1. SECTION A – Biographical data

This section offers an outline of the study participant's biographical characteristics with a brief narrative of the Word Cloud. To evaluate the effective monitoring of vehicle utilisation using the eThekwini Municipality fleet management systems, qualitative data from interviews with the five (5) participants were gathered for this section. It further illustrates a word cloud as illustrated in Figure 4.1, highlighting the trends and patterns in the research. the Word Cloud incorporates the structure and patterns across the study.

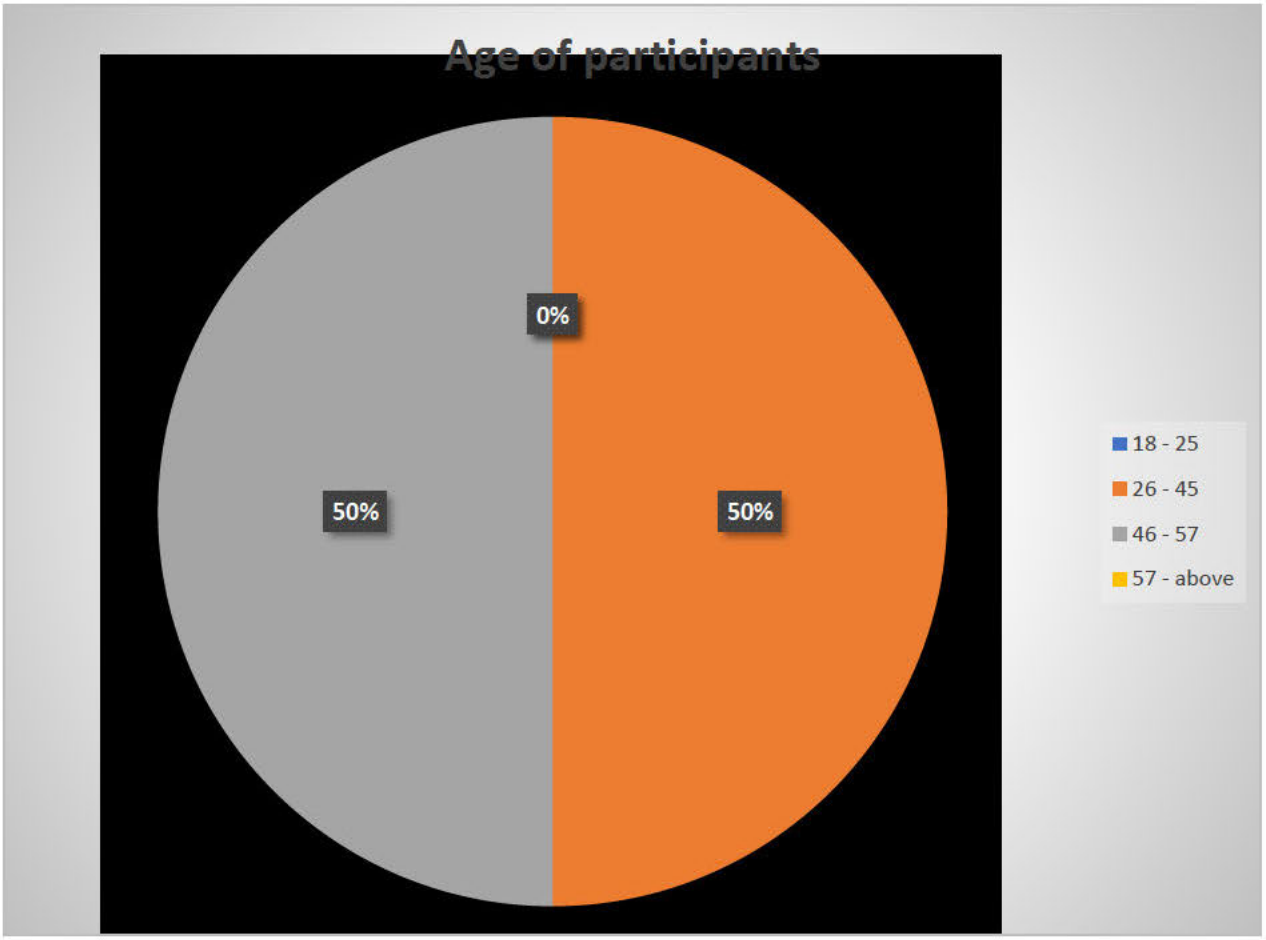
Figure 9: Word Cloud of Key Themes

4.3.1.1. Age of participants

The purpose of this point was to establish the age range of participants to see if age influences employment experience within the eThekwini Municipality. Four categories were given, allowing for participants to indicate their age group. The categories were as follows: 18-25; 26-45; 46-57 and 58-above. The following results emerged.

Results:

Figure 10: describes the age of participants.



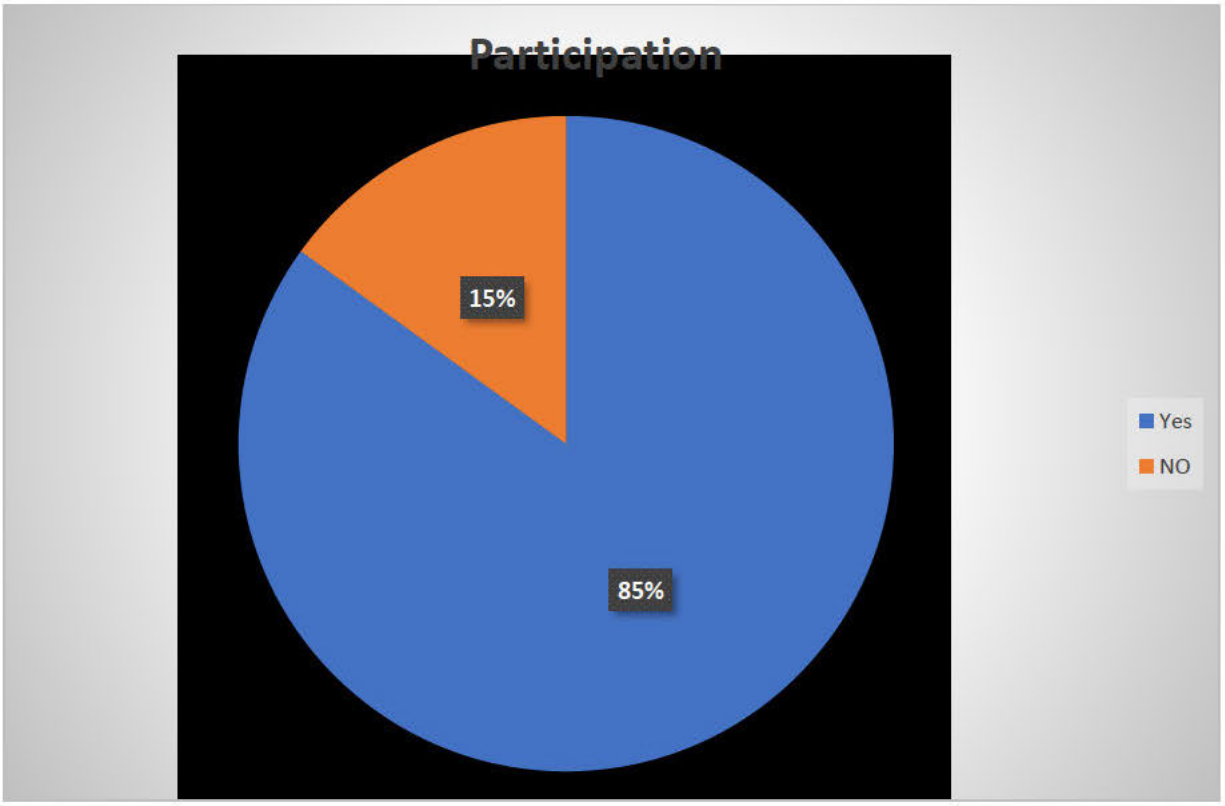
The study **found** that 50% of the participants were between the ages of 46 and 57. This was followed by 50% of individuals between the ages of 26 and 45. 0% were between the ages of 18 and 25, and 0% were aged 58 and up. This resulted in equal representation from participants aged 46-57 and 26-45.

4.3.1.2. Participation in monitoring vehicle utilisation using FMS on a direct basis.

The researcher included this item to determine how much participants know about monitoring vehicle utilization with FMS. Is their knowledge and experience deeply rooted in this sector? The following outcomes emerged:

Results:

Figure 11: Participation in monitoring vehicle utilisation using FMS on a direct basis.



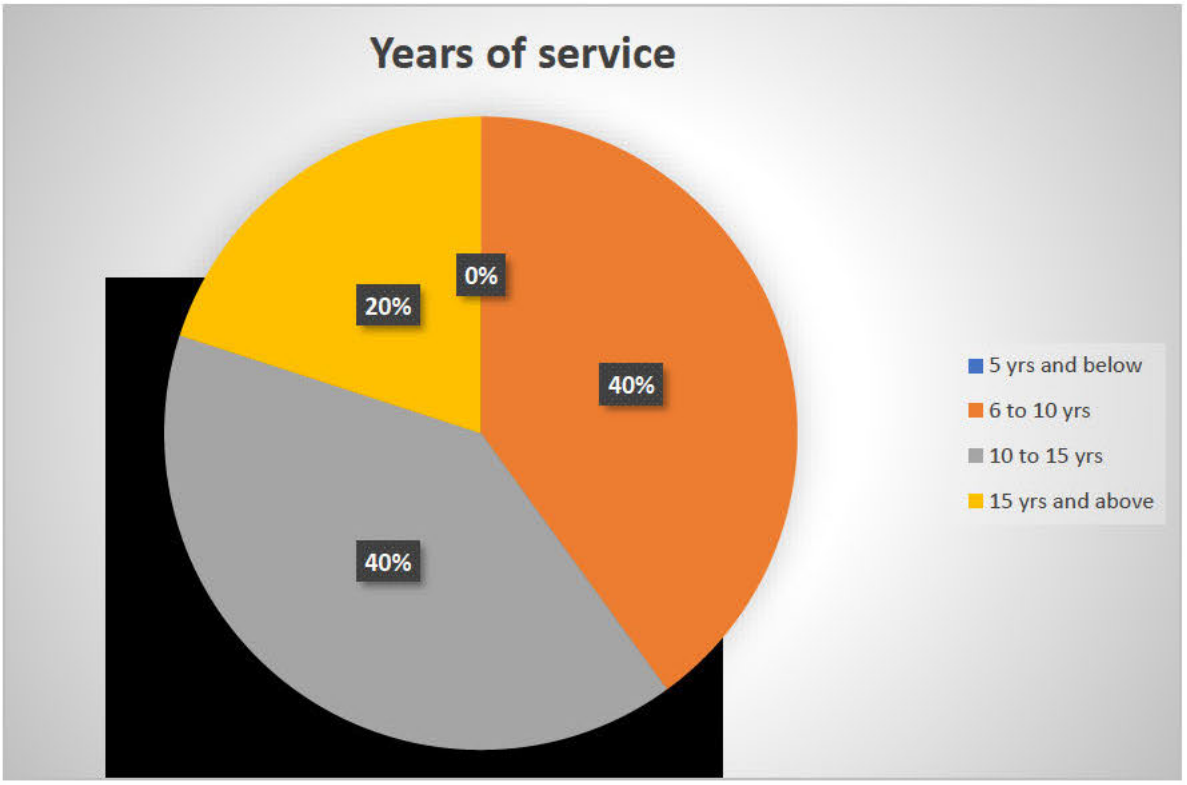
The researcher discovered that 85% of the participants were directly involved in the relations of the monitoring vehicle utilisation using FMSs and 15% were partly involved. The 85% of the participants showed the use of the system as their daily working tool in terms of live monitoring and 15% of the participants are back-office system administrators who monitors productivity of the fleet management systems The participants portrayed extensive knowledge on the subject matter.

4.3.1.3. Years of service

The study included this information to determine the participants' years of service.

Result:

Figure 12: Participations years of service



The study found that category 40% of the participants' years of service was in the category of below 5yrs and 6 to 10 years. Some participants stated that they had previously worked for different companies before joining the eThekwini Municipality. For example, one participant indicated that she worked for telecommunication company as a Systems Administrator: Analytics for 3 years and 2 years as a Systems Administrator: Tracking within the tracking company which is widely known within the country.

This section (B) discusses the themes and sub-themes that evolved during the coding process. These themes and sub-themes emerged from the questions and answers provided by the participants; the results are listed below:

4.3.2 SECTION B - Data analysis and discussion

Qualitative data analysis is a process of the description, classification, and interconnection of phenomena with the researcher's concepts. The phenomenon of the research study needs to be described precisely. which necessitates the development of a conceptual framework and the classification of data. Following that, concepts can be formed and linked to one another (Maxwell, 2013). Qualitative data analysis has the following general aims (Flick 2013):

> *'Describe a phenomenon in some or greater detail Comparing several cases on what they have in common or on the differences between them Develop a theory of the phenomenon under study from the analysis of empirical material'.*

Analysing the data gathered from participants' periods of work experience within the organisation contributed progressive insights in informing the analysis. Analysing the data gathered from the study participants resulted in identifying the themes derived from the research questions. In 4.3.2 - Section B, interviews with five participants who are permanent employees at eThekwini Municipality department of City Fleet will be presented in the form of discussions (and inserting the excerpts). The qualitative analysis has generated five key themes, namely:

THEME 1: Effective monitoring of vehicle utilisation using fleet management.
THEME 2: Effectiveness, efficiency, and productivity of fleet management system.
THEME 3: Live monitoring: vehicle utilisation and driver management
THEME 4: Effects and challenges of poor fleet management system
THEME 5: Fleet management system framework solution

Interviews were conducted with participants according to their respective roles, namely:

- Two (2) Vehicle Monitoring Centre Supervisors (P1 and P2)
- Two (2) Fleet Systems Administrators (P3 and P4)
- One (1) Vehicle Monitoring Centre Manager (P5)

Table 5: Emergent main themes from research data

No.	Main themes	Sub themes
1.	**Effective monitoring of vehicle utilisation using fleet management systems.**	• Vehicle utilisation • Aspects the fleet management system • Challenges in managing monitoring of vehicle. utilisation
2.	**Effectiveness, efficiency, and productivity of fleet management system.**	• Efficiency • Importance of Efficiency • Factors affecting monitoring of vehicles using fleet management system. • Effective measures that the system should carter to improve productivity
3.	**Live monitoring: vehicle utilisation and driver management**	• Effects of driver performance in eThekwini Municipality • Measures of driver behaviour • Factors to promote driver behaviour patterns
4.	**Effects and challenges of poor monitoring fleet management system**	• Concept of fleet management system • Importance of feet management system
5.	**Fleet management system framework solution**	• Causes and effects of poor fleet management system. • Measures that can be taken to enhance effectiveness of the current fleet management. • Adapting of innovative technology

THEME 1: Effective monitoring of vehicle utilisation using fleet management.

4.3.2.1.Understanding of vehicle utilisation

It has been indicated in the literature review that companies can use a tracking system to improve fleet utilisation. Organisations can track and monitor the time spent in specific locations of drivers and vehicles. Routes taken to see if the resources are being over-or under-utilised, Le Roux (2022: 4). Emanated from the interview, the participant's understanding of the concept in agreeing with the content outlined in the literature review, participant's responses are stated below:

"*Vehicle Utilisation is to fold; it determines usage of vehicles by 0 usages or usages. Here are various measures of utilisation; these include mileage or hours (kilometres per vehicle per period or working hours/days per vehicle per period); analysis of days or hours of operation as a percentage of total available time; or the number of vehicles operated in a day as a percentage of the number."*

(P1) and (P5) "Vehicle utilisation is hereby the usage of the vehicle and calculated, or how the vehicle was used in a certain period, it can be a day, week, monthly and quarterly."

(P2) "Municipality is using the tracking system data to monitor vehicle utilisation of the fleet, according to the experience within the municipality vehicle utilisation is based on the period of vehicle usage and how it is used".

(P3) "Vehicle utilisation criteria should determine a minimum number of kilometres, days or trips a vehicle should be used in each period to be considered adequately utilised."

(P4)

Apart from the definition of the concept, (P2) indicated that for every organisation equipped with a fleet, the important aspect is to conduct business operations. The vehicle utilisation rate highlights the organisation fleet's capacity against business operation needs, i.e., goods and service delivery, ambulances etc. This view is supported by the participant, who states,

"*eThekwini Municipality is using the tracking system data to monitor vehicle utilisation, according to the level of work experience within Council. Vehicle utilisation is based on the period of vehicle usage, how it is used and is linked to service delivery." (P2)*

Drawing from the above participant's comments, about 99% of respondents comprehend the concept of vehicle utilisation. As discussed in the literature review, vehicle utilisation involves measuring fleet performance or use. Demand and fleet capacity are compared to determine fleet utilization. The method used to manage it changes every day as capacity and demand classified.

4.3.2.2.Importance of fleet management systems at eThekwini Municipality

The fleet management system oversees regulating vehicle operation and assessing adherence to scheduled services, according to Rojas et al. (2020:2). In general, the technologies provide real-time vehicle monitoring, minimize risk, boost service quality, and increase operational effectiveness. Each participant gave a comprehensive response indicating the importance of fleet management system in improving service operation by stating the following:

> "*Fleet management system is employed to safeguard and monitor movement and also to safeguard municipal asset, eThekwini Municipality implemented the installation of vehicle tracking devices to all municipal vehicles to enable users to monitor vehicles, driver behaviour, service delivery and misuse of the municipal fleet."*
>
> *(P1)*

This statement qualifies with P2 and P4, working within City Fleet VMSC, who says, "Fleet management system is used to safeguard assets and it also employed to enable user department to set standards to tie up with the business operation" counters by stating the following:

> "*The organisation intends to monitor the movement of assets. eThekwini municipality department of city fleet (VMSC) is the unit that is assigned to monitor fleet utilisation. The monitoring centre uses a tracking system to monitor the movement of the municipal fleet to ensure optimum vehicle usage."*
>
> *(P3)*

P5 further outlined that:

> "*City fleet (VMSC) work hand in hand with user departments to ensure optimum vehicle utilisation. A tracking system enables fleet operators to optimise the best routes for service delivery in line with business operations.*
>
> *(P5)*

Data gathered from the interviews reveals that most participants support the participant's statement, with another P1, P3 and P5 stressing that:

"The fleet management system is important to the organisation to control fleet. Incorporating a tracking (software) system that monitors fleet in real-time basis can improve vehicle life span, driver behaviour, reduce accident and other risk factors that may occur."

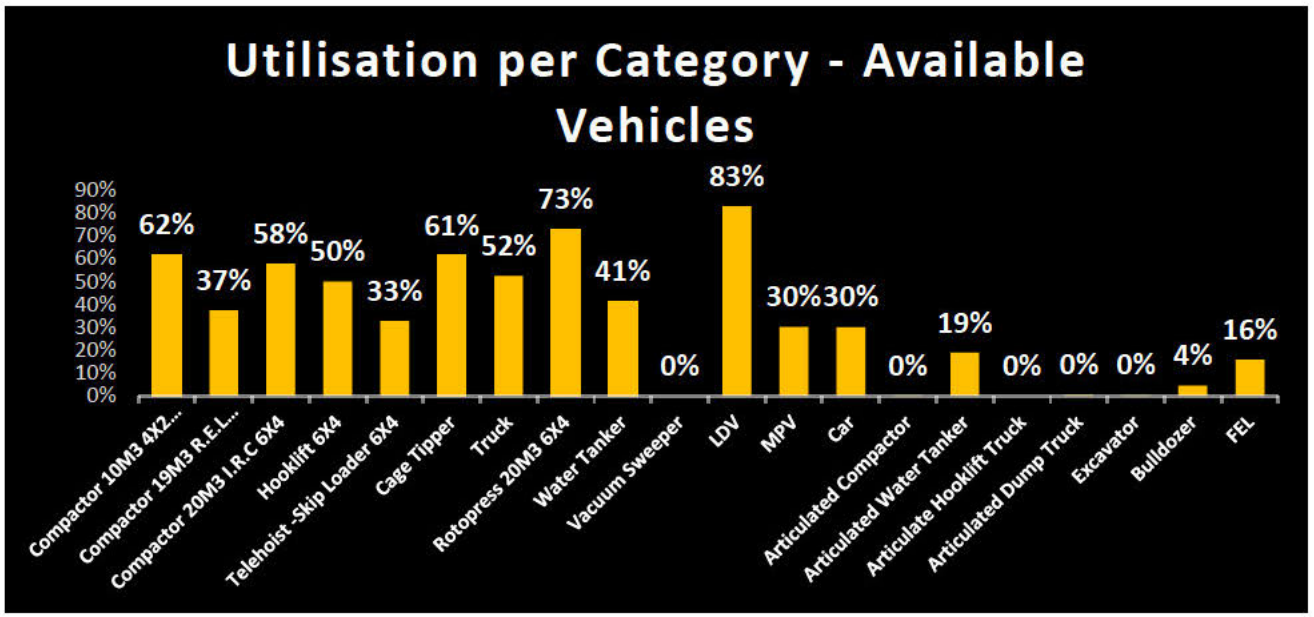
(P1), (P3) and (P5)

4.3.3.3 Challenges of monitoring vehicle utilisation using the fleet management system at eThekwini Municipality

The researcher posed this interview question to consider various experiences relating to monitoring utilisation using fleet management systems. To establish challenges or difficulties that may have been encountered. Furthermore, the research question is also intended to allow participants to express their sentiments and views fully.

Figure 13: monthly vehicle utilisation per vehicle category

– available vehicles. This participant additionally reflects on the benefit it brought to the organisation as the report is generated manually:



Source: Tracking system:2022

"*The main challenge is collecting data and understanding the data generated by the system. The current system is critical in managing and maintaining the current fleet. However, it does not contain real-time data that is available from the vehicles' sensors and onboard interfaces."*

(P1)

"*Challenges are the system's instability; the reliance is on the system to generate data. The municipality department of SCM must ensure that when advertising the contract for the nomination of the service provider, all items are clarified, categorised and clear to ensure that the service provides nominated activities as per tender specification."*

(P2)

Other participants recorded,

"*Regular and on-time vehicle maintenance is one of the biggest challenges faced. The fleet management system does not carter for automated preventive maintenance schedules so that user departments/drivers will know when vehicles are due in for service maintenance. "Another challenge with the system is the accuracy of the data integrity "The instability of the system and data integrity (inaccuracy of data) is an ongoing issue."*

(P3 and P5)

P4 outlined a similar circumstance to P3, and P5 stated that:

"*There are a lot of challenges and gaps in the system, data integrity due to system instability. System instability causes challenges in retrieving accurate data. Data can be delayed and data in and out. The system is not updating regularly, which has an effect in terms of investigations.*

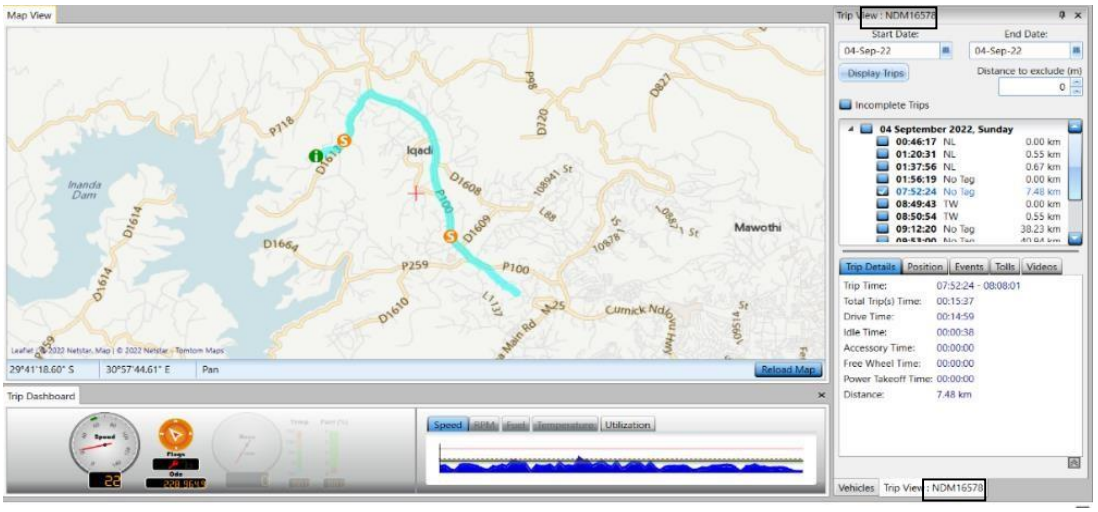


Figure 14: Map showing missing data (system gap)

Source: Tracking system:2022

The above figure attests to the statement outlined by P3, P4 and P5 from the system. These are cases where trip replays do not show trips for a specific vehicle during a limited time, while further analysis indicates that the vehicle did move during that time and that there are data points available in Big Data for that period. This finding, supported by the literature review posed by Bakır (2017: 20), stated that fleet data collection imposes great challenges to fleet managers effectively and efficiently collect, store and process fleet performance data on time.

THEME 2: Effectiveness, efficiency, and productivity of fleet management system.

4.3.2.4. Understanding efficiency

The researcher found that a fleet's overall efficiency depends on the vehicles' performance. All activities on the ground related to the fleet mostly rely on the aspect of fleet management. As stated by (Bakır (2017: 20), companies can have all the data worldwide; however, the efficiency and productivity of the data make the difference in the ability to access or analyse real-time data. Below are the participants' points of view regarding the efficiency of the system:

> "*Efficiency of the fleet management system is to provide real-time data and to monitor the movement of the vehicles. Also, to track the vehicle route to ensure linkage between the service that is being delivered and optimum vehicle utilisation."*

(P1)

The other two participants understand that:

"*The efficiency in fleet management is running fleet effectively by improving operational performance and reducing costs of the running fleet."*

(P2) and (P4)

Participants highlighted the most collective understanding of the concept during interviews:

"*Efficiency is availability in cases whereby the system is stable, available and has correct data for the fleet to run successfully."*

(P5), (P1) and (P3)

The last participant supplemented that:

"*Efficiency is based on the system's productivity. In a more general sense, it is the ability to do things well, successfully, and without waste."*

(P5)

4.3.2.5.Importance of efficiency at eThekwini Municipality

Efficiency in the business measures how efficiently a business uses resources. Being efficient in day-to-day operations helps improve productivity, increase business operations output, and eliminate time-consuming administration tasks. Below, participants explained the importance of efficiency in the organisation:

"*In our environment, efficiency is important to ensure the smooth running of the core business function including improved fleet safety, improved driver and fleet security, increased fleet efficiency, fleet compliance and data integrity.*

(P1) and (P5)

P4 explains:

> "*Efficiency is important to the organisation; the reliance is on the system's productivity. t some instances, user departments would want to monitor the whereabouts of vehicles to ensure that the service delivery is delivered timeously."*
>
> *(P4)*

P3 and P2 indicated that efficiency is important for any organisation to keep up with the daily, weekly, monthly, and quarterly reporting.

> "*The system can also assist user departments in generating reports on daily, weekly, monthly, and quarterly" There is a need for system enhancement or platform that analyses and identifies issues of vehicles which ensures immediate intervention."*
>
> *(P3) and (P2)*

This response relates to evaluating the effectiveness of effective monitoring vehicle utilisation using a fleet management System. Participants P3 and P2 indicated a need for a platform that can provide real-time analysis and identify vehicle issues, ensuring immediate intervention (AgileTech, 2020); outlined that beyond operational Efficiency, IoT technologies allow fleet managers to achieve higher standards of sustainability and corporate responsibility.

4.2.3.6.Factors affecting monitoring of vehicles utilisation using fleet management system.

The following extracts from the focus group highlight the preceding discussion on the factors affecting the monitoring of vehicles:

a) Live Monitoring - Lack of Resources

> *"The factor's affecting the fleet is the number of people employed to monitor the municipal fleet. Here are three users and one supervisor allocated per shift at the monitoring service centre to monitor +/- 9000 municipal vehicles" It is a concern since some other events are not on a real-time basis hence.*
>
> *(P1)*

b) Lack of support - support from employees and service provider

"*The willingness of employees to provide effective support and the support from the service provider when an organisation has customised requirements, and the ability of the service provider to deliver those requirements which is currently a challenge at the present moment."*

(P2)

"*There is a lack of resources within the department, hence its impacts the whole process of monitoring. Alarms can be effective and more visible."*

(P4)

c) Actions and decisions on a real-time basis

"*The challenges affecting monitoring vehicles are that vehicles are not reporting current data and time that impacts the service operation. Therefore, there is a lack of retrieving real data" The instability of the system is also a challenge; there is a delay in sending alerts."*

(P3) and (P5)

Drawing from the participant's responses, the current monitoring processes are resource-intensive, and many manual interventions are involved in achieving the objectives. There is a need for the organisation to revise its structure and consider placing additional resources to ensure the smooth running of business operations. Further, the P5 and P5 heightened the challenges of vehicles not reporting current dates and times. n case of Chiparo et al. (2022:165) study indicated that the advancement of fleet management technology, a communications system and state-of-the-art management techniques plays a vital role in the development of transport networks, sustainability, and adaptable service demands.

4.3.2.7.Effective measures that the system should carter to improve productivity.

The fleet management system sends alerts on a real-time basis, which is after effect. The figure below depicts the departmental alarms forwarded to eThekwini Municipality departments.

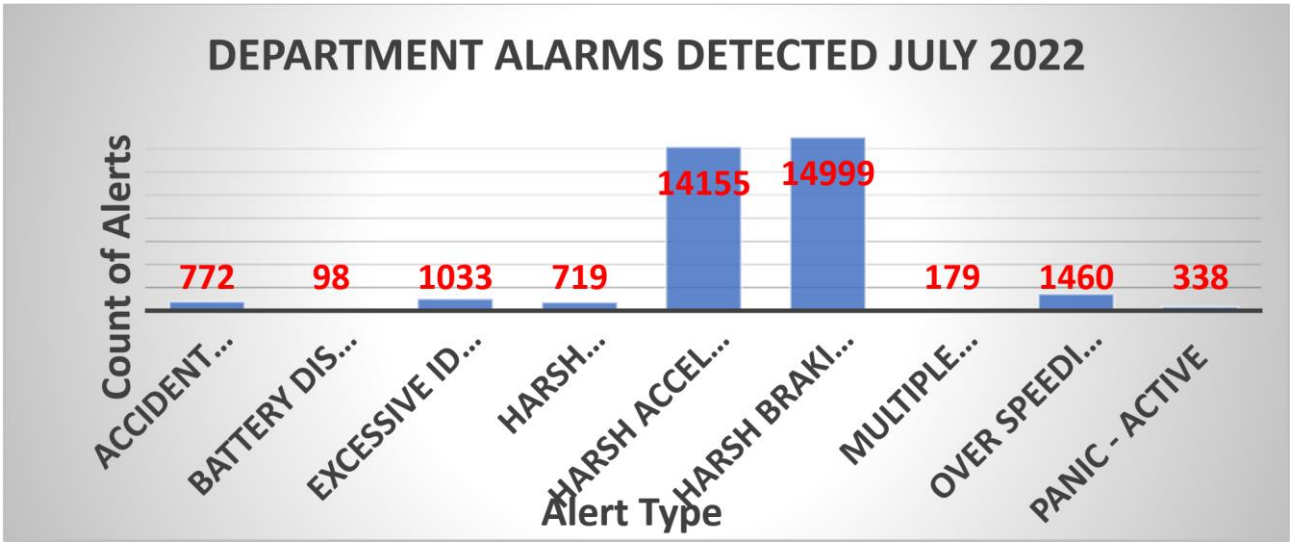


Figure 15: Live monitoring (Alarms)
Source: VMSC (2022)

Building on the above, this is after the effect, and there is no active mechanism for receiving alerts in real-time based on operational requirements and criteria. The fundamentals depicted herein verify (Frotcom, 2020) research, which presented that alarms are a handy feature for companies to respond quickly to any inconvenient situation regarding fleets. Le Roux (2022: 4) found that GPS and IoT platforms can produce real-time alerts and warnings when a vehicle's consumption exceeds the defined parameters.

> *"Alarms can be effective and more visible. Additional resources are required to monitor effectively."*
>
> *(P1) and (P2) "Importance of research and development is a critical path in making progressive in managing the organisational fleet. There is a disconnect between the service provider and requirements to be delivered as per the specification."*
>
> *(P3) and (P4) "Alerts and notifications help businesses to monitor fleet drivers in real-time. The system does not carter a real-time alert in terms of roadside assistance. This category is required to minimise unnecessary administration work." (P5)*

THEME 3: Live monitoring: vehicle utilisation and driver management

4.3.2.8.Effects of live monitoring at eThekwini Municipality

Smart track (2020) utilised a three-factor structure (aggressive violations, ordinary violations, and errors) to compare driving behaviours across countries and found that the importance of driver characteristics and behaviours in predicting traffic accidents varies from country-to-country Monnerat et al (2019) found that although there are a lot of driving practices during the learning period, the probability of making mistakes in the early license-holding period is still high. In conclusion, a lack of driving experience is a safety threat to drivers, passengers, and other road users.

> *"Driver scorecards from the vehicle tracking data are available after a trip, and there is no pro-active monitoring of driver behaviour."*
>
> *(P1) and (P2)*
>
> *Driver behaviour and mechanical or electrical issues with a vehicle can also affect fuel consumption. Also, fuel theft can only be identified after the effect. in such cases, no platform will produce real-time alerts and warnings when a vehicle's consumption is beyond the defined parameters."*
>
> *(P3) and (P4) "One of the biggest concerns for the Council is the rising cost of fuel. The drivers' behaviour and driving style affect a fleet's fuel efficiency.*
>
> *(P5)*

4.3.2.9.Effects of monitoring vehicle utilisation at eThekwini Municipality

According to Saghaei (2016:2) study, knowing where the vehicles are, what the drivers are doing and monitoring every event are the critical parameters for a well-managed decision-making process. The below table reflects driver behaviour within eThekwini Municipality using FMS (tracking data). The driver score is generated with the following driving concerns: Over speeding, over-revving, over-idling, harsh braking, harsh accelerating, and harsh cornering. Driver scorecards from the vehicle tracking data are available after a trip, and there is no effective monitoring of driver behaviour. From data drawn from the system, a driver can be assessed and categorised as follows:

Red= Bad Yellow = Mediocre Green = Good

Table 6: Top 5 Bad Driving Scores

Driver Name	Counts (total alerts per month)
Driver 1	8317
Driver 2	4179
Driver 3	3793
Driver 4	3512
Driver 5	3171

Source: Tracking data (2022)

Table 7: Top 5 Good Driving Scores

Driver Name	Comments
Driver 6	
Driver 7	
Driver 8	
Driver 9	
Driver 10	

Source: Tracking data (2022)

> "*In our environment, we monitor driver behaviour by receiving alerts from the existing fleet monitoring system and the categories of drive behaviour used within my environment is: harsh breaking, harsh acceleration, harsh cornering, over speeding and over-revving in order to improve bad driving" And every month, VMSC sends driver score cards to line departments."*
>
> *(P1)*
>
> Other two participants inputted that: "*Recording driver safety monitoring data such as harsh acceleration, harsh cornering, harsh braking is to ensure safety regulation compliance."*

(P5) "The driver score attributes over speeding, over-revving, over idling, harsh braking, harsh accelerating, and harsh cornering."

(P4)

P3 added that driver performance and behavioural patterns are measured by the "*Driver score card, which reflects drivers that have highest and lowest deviations."*

(P2)

4.3.2.10. Effects of monitoring driver behaviour

The VMSC manager (P5) posed the question to establish the purpose of monitoring driver behaviour and effective ways to promote good driver behaviour.

"In our organisation, driver behaviour is a key part of operational and reputational management for business operation. t is particularly critical in fleet management and fleet industries, as implementing more effective and accountable driving practices could not only increase the organisation's bottom line but also inculcate far better safety."

Turnaround time for monitoring repetitive aggressive driver behaviour mentioned by P5.

"*Repetitive aggressive driver behaviour to be monitored on a month-to-month basis, the highest number of violations to be escalated also recommends refresher driver training.*

Further added that: -

" *Investigate whether its driver related (accident, fines, and maintenance) or vehicle related (tracking etc.).*

If it is driver related – recommend refresher training or the vehicle related referred to the workshop for repairs.

(P5)

This result is consistent with the (Flowers, 2019) research study use of a driver management system, which enables businesses to gain a thorough understanding of drivers' performance, productivity,

and overall asset safety. According to Flowers (2019), a driver management system might automatically upload important data for your fleets, like fuel consumption and telemetry data. Fleet managers can find areas for improvement by receiving real-time data on your drivers and equipment.

THEME 4: Effects and challenges of poor monitoring using fleet management systems.

4.3.2.11. Understanding fleet management systems

The fleet management system oversees regulating vehicle operation and assessing adherence to scheduled services, following the Rojas et al. (2020:2) study. FMS monitors vehicles in real-time, lowers hazards, boosts service quality, and enhances operational efficiency at a low cost. Mehmood (2021:25) went on to say that you need a fleet monitoring system to make sure that your drivers and fleet are safe from traffic accidents and that they satisfy the needs of your regular business operations.

> "*The fleet management system is an organisation's function to manage the fleet." (P1)*
>
> "*Fleet management system is basically to monitor the movement of the fleet, vehicle utilisation, the safety of the fleet and drivers. The system also generates real-time data for live monitoring."*
>
> *(P3 and P3) "In effect, it is a sophisticated database with numerous applications that enables an organisation to record and report the key attributes that can help improve efficiencies and drive down costs by reducing downtime and improving productivity*." *(P4)*
>
> "*Fleet Management system is important to safeguard an organisation's asset. The purpose of the fleet management system at eThekwini municipality is to improve efficiency and productivity, reduce costs, stay compliant, and improve customer satisfaction."*
>
> *(P5)*

4.3.2.12. Importance of fleet management system at eThekwini Municipality

The fleet management system has impacted how companies monitor vehicles in real time. The location of trucks and other parameters like speed, acceleration, and braking actions can also be monitored remotely. Hence, you can ensure when the driver delivers services to communities.

"*Fleet management system is one of the important fleet management aspects that is used to monitor vehicle movements, improve the effectiveness of vehicle utilisation and efficient management of fleet to improve service delivery in the Municipality."*

(P1)

"*In our organisation, the fleet management system is a tool used to monitor and plan for the regular repairs and maintenance of the fleet of Council. To procure and control the issue of fuel required by vehicles in respect of vehicles under the control of the municipality."*

(P2) and (P5)

"*To deal with accidents, breakdowns, injuries to employees and other office bearers impacted while driving municipal vehicles on duty. To ensure that drivers have the required driving license; to take such measures as are necessary and in consultation with municipal line departments and Heads of departments."*

(P3)

"*This telematic tool keeps records of aforesaid trip authority related to a trip necessary for the performance of a line function of a department or in furtherance of the municipality's lawful aims and or objectives.*

"*The use of the system is important to record the following key performance:*

- *Kilometres travelled.*
- *Fuel utilisation*
- *Total maintenance costs*
- *Running cost per kilometre*

Performance "These key indicators are to be calculated on the fleet monthly summary form" The reports are generated on the system and forwarded to line departments to do analysis and to ensure optimum vehicle utilisation." The manual generated report is shown on the below table:

(P4)

Table 8: Fuel report

Department	Litres	Litres	Cost	Mileage
Cleansing & Solid Waste	364,169.40	329,586.85	6,386,015.00	874,106.63
Community Participation	31,573.29	26,587.53	549,228.49	229,471.30
Electricity	167,555.03	152,279.13	3,041,249.86	1,591,761.35
Fire & Emergency Services	23,893.98	20,082.38	396,217.29	96,429.93
Health	17,016.01	15,538.35	330,370.44	147,048.87
Metro Police	118,949.09	98,190.11	1,997,758.50	769,908.38
Other Departments	206,707.88	188,020.16	3,838,164.63	1,993,749.32
Parks	126,787.48	112,298.39	2,223,857.74	623,432.05
Roads & Stormwater	77,372.06	73,032.49	1,425,621.07	327,558.30
Water & Sanitation	756,994.63	685,470.40	13,284,335.82	2,120,265.94
Grand Total	**1,891,018.85**	**1,701,085.79**	**33,472,818.84**	**8,773,732.07**

Source: Tracking data (2022)

As discussed in the literature review chapter, Ramirez et al. (2018:12-18) stated that transport is essential in the process. Organisations leverage the benefits of information systems to reduce transport costs and improve productivity. According to Chaba (2021: 71), telematics technology solutions can track the variables related to a driver's driving and driving style, providing crucial risk assessment information. He confirms the assertion made by P1, P2, P4, and P5.

THEME 5: Fleet management system framework solution

4.3.2.13 Causes and effects of the poor fleet management system at eThekwini Municipality.

In conversing with participants, the researcher noticed that the words' reliability and productivity of the system in terms of data integrity had been mentioned as a concern. As part of the research, participants recommend fleet system enhancement to make business operations more seamless and

efficient. These responses were confirmed by the conclusion of Clark (2018), assuring that ecommerce is the future and is not going away anytime soon. Some participants responded by stating that:

"*Real-time routing impacts the business operation as the system does not provide data in real-time to monitor route optimisation for efficient planning. t decreases the reliability of the business organisation in adhering to timelines and deadlines to service delivery."*

(P1) "The instability of the system and data integrity (inaccuracy of data) is still an ongoing issue, Fleet Systems, and compliance section to consider system enhancement and consider the advancement of fleet management technologies ensure optimum vehicle utilisation." (P2)

"*There is no linkage between the service that is being delivered and the vehicle. Therefore, there is no live measuring of actual versus schedule" The Fleet IoT automated platform can assist the Council in identifying the potential problems sooner*.

(P3) "There is no pro-active monitoring if the services are delivered within an area the vehicle is allocated to service (North, West, South or Central". "Driver scorecards from the vehicle tracking data are available after a trip, and there is no pro-active monitoring of driver behaviour."

(P4) "A Fleet IoT platform can assist the organisation by automating processes and provide real-time visibility into everything that goes on with a vehicle in the field."

(P5)

4.3.2.14 Effective measures to improve monitoring vehicle utilisation using eThekwini Municipality's FMS.

"*Implementation of fleet management platform that can monitor vehicle utilisation in real time like IoT platform on the existing system".*

(P1)

"*Implementation of GPS IoT platform. Fleet system enhancement to monitoring vehicles, managing performance, and maintaining vehicle utilisation to make informed decisions that improve efficiency, increase safety and lifespan of fleet vehicles."*

(P2) and (P3)

"*System enhancement to tie up with evolving technology and implementing effective monitoring tool to improve vehicle utilisation, effectiveness, and service delivery. Implementation of IoT platform."*

(P2) and (P3)

4.3.2.15. Adopting fleet monitoring systems technology advancements to improve service delivery at eThekwini Municipality.

Scholars have revealed that social media has proved to be fast and instant communication adopted by countless people in society (Icha, 2016; Matali, 2018). his participant implies that failure to adapt to the new communication method will result in the organisation lagging.

"*Technology is advancing worldwide; the organisation should embrace and keep up with new technology for what it can produce towards the business operation."*

(P1)

"*Technology is evolving; it can become cheaper and expensive depending on the acceptable tool. For instance, a municipality uses a service provider (nominated contract) to install tracking devices in all municipal vehicles. In contrast, there is an advancement where vehicles are dispatched with tracking devices already installed. This technology advancement should be considered and implemented to minimise time spent and costs."*
(P2) and (P5)

"*Technology is evolving, adapting of new technology can make life easy, improve system functionality and the ability to develop new, innovative approaches."*

(P4) "*Technology is constantly changing; municipality must always keep abreast to improve service delivery to the communities."*

(P3)

4.5 Conclusion

Data for the research study was gathered from respondents in the eThekwini Municipality's City Fleet, randomly chosen for sampling, and then analyzed to see how actively the fleet management system was being used to monitor vehicle usage. The department's sample size is five (5) correspondents in total. Given that the components in the sections of the City Fleet Unit represented the diversity of the population under study and were consistent across them, it was determined that this sample size was suitably representative of the total population. The study used a purposive sampling methodology and interviews were conducted with selected participants.

Open-ended online interviews were used in the qualitative research approach to elucidate more data and assess the effect of monitoring vehicle utilisation using fleet management systems system were discussed. To aid in the comprehension and processing of precise and succinct results, the descriptive technique, and the content analysis way of handling the data collected and the data analysis were used in the study. The findings indicated a general improvement in the organization's vehicles' overall monitoring performance.

According to the research findings, service delivery to the eThekwini Municipality program is influenced by factors such as monitoring, vehicle utilisation, tracking service delivery, fleet management system effectiveness, vehicle and driver monitoring, repairs and maintenance, live monitoring, and day-to-day and monitoring usage rates of vehicle breakdowns. The study also concludes that the fleet management system allocation/routing, driver behavior observation, fleet administration and costing, real-time positioning data, and maintenance scheduling are all factors that affect how effective the eThekwini Municipality program is implemented.

The study comes to the additional conclusion that fleet management, planning, effective monitoring of vehicle utilisation, live monitoring, route management and driver management additional ways that affect service delivery in the eThekwini Municipality program. The analysis concludes that the greatest impact on service delivery came from increasing technological breakthroughs in real-time monitoring of vehicle utilisation.

CHAPTER FIVE: RESEARCH FINDINGS AND RECOMMENDATIONS

5.1 Introduction

The overall purpose of the study was to evaluate the challenges relating to monitoring of vehicle utilisation using eThekwini Municipality fleet management systems. The previous chapter four presented the results emerging from the five themes in respects of the data that was collected through interviews. The overall objective of this chapter is to present conclusions and viable recommendations based on both primary and secondary data. Additionally, this chapter five provides a thorough analysis of the study findings based on information gathered from respondents within City Fleet of the eThekwini Municipality who were chosen at random for five sample of employees.

5.3 Summary of the Research Findings

This section aims to summarise this research study key findings concerning each objective mentioned above in chapter one. The study focused on demonstrating an understanding of the importance of effective monitoring vehicle utilisation using fleet management systems and how municipalities and other organisations can use the system to improve service delivery.

Objective 1: To evaluate the effective monitoring of vehicle utilisation using a fleet management system.

The main challenge is collecting data with monitoring vehicle utilisation and understanding the system's generated (real-time data). Vehicle utilisation itself must be defined either by the user department or the city (eThekwini Municipality) to improve operational efficiencies and productivity.

The instability of the system and the reliance on it to produce data present difficulties. One of the concerns is timely and regular vehicle maintenance. Preventive maintenance schedules can be automated by organizations so that user departments and drivers are informed when vehicles need service maintenance. Users of fleet management can also set up alerts to notify drivers when fleet vehicles require unforeseen maintenance based on engine data. These reminders can be set by administrators or users depending on time, mileage, or usage hours. By keeping track of and planning maintenance in this way, you can save money and maintain the functionality of your vehicles.

Data Integrity: The main challenge with the system is the accuracy of the data integrity. There are numerous challenges and gaps in the system, which yields in the inaccuracy of data. System instability causes challenges in retrieving accurate data, can be delayed, and data in and out. The system is not updating regularly, which has an effect in terms of investigations.

Real-time analysis of service delivery in the areas: There is no effective monitoring if the services are delivered within the area where the vehicle is allocated to service (North, West, South or Central). Multiple vehicles can go back to address the same fault. There is no way of determining whether it is a repeat or a duplication.

Employees at City Fleet of eThekwini Municipality perceived the fleet management system to be productive and provide data on a real-time basis. t was established that the system's instability impacts monitoring vehicle utilisation in real time.

Efficiency: Participants understood efficiency and its importance to the organisation; it was further indicated that the effectiveness of monitoring vehicle utilisation relies on the system's productivity. Participants expressed that in some instances, user departments would want to monitor the whereabouts of vehicles to ensure that the service delivery is delivered timeously. To improve fleet management efficiency, participants suggested putting good planning procedures and smart fleet management technology in place.

Furthermore, the focus group participants affirmed that the system could also assist user departments in generating daily, weekly, monthly, and quarterly reports. Implementing a tool for monitoring routes can reduce costs and enable the user to monitor the vehicles' whereabouts and identify the causes of the vehicle's malfunction. Furthermore, it can assist user departments in identifying vehicles and how they are being utilised in line with the departmental service operation.

Regarding operational vehicle costs, mileage readings generated from the system are incorrect, and kilometres travelled are correct. Regarding costs, users use reports to cross reference with fuel reports; however, it is impossible to execute if fleet management systems do not correspond. There is no effective tool to alert or notify back-end users in cases whereby vehicles are not reporting.

Driver safety is critical to drivers. There is a gap whereby the feature installed in municipal vehicles are not effective and not executed properly.

Objective 2: To explore the root causes of challenges experienced during the monitoring of vehicle utilisation using eThekwini Municipality FMSs.

This objective aims to determine the causes and effects of the fleet management system and the challenges faced in monitoring vehicle utilisation. Also, to identify the effects of the poor fleet management system at eThekwini Municipality.

The fleet management system monitors the fleet's movement, vehicle utilisation, and safety of the fleet and drivers. The system also generates real-time data for live monitoring. The in-vehicle tracking system may monitor factors such as speeding, harsh braking and acceleration, abrupt steering changes, over-revving, and the number of hours spent driving. By encouraging a culture of constant driver improvement and favourably influencing driver behavior, this information can lower accident rates and fuel consumption. This information can be used to dispute responsibility in the event of an accident and provide specifics about the seconds just prior to one, such as speed, steering, and braking.

In essence, it is an advanced database with a variety of applications that enables a company to collect and report the essential characteristics that might assist increase efficiency and save costs by boosting productivity and lowering downtime. The willingness of employees to provide adequate support and the support from the service provider when an organisation has customised requirements and the ability of the service provider to deliver those requirements which is currently a challenge at the present moment.

Safety: safety is important to every individual and any business. As a result, it should be run in a way that creates an effective and efficient transportation system. To do this, it is necessary to assess performance and driver behavior by measuring service delivery, driving behavior, and data integrity. Safety measures evaluate the likelihood that drivers will be involved in an accident, be it vehicular or safety. Safety can lead to the loss of lives or business. It also involves the public in terms of accidents which ties up with driver behaviour and vehicle operation. This item plays a vital role in terms of safety.

Safety programs: implementing a fleet safety program reduces the risk of damage to other properties and injuries against other people and to customers that are being directly stolen, and safety of the drivers can know the whereabouts of the drivers in terms of monitoring vehicles and organisation fleet.

Live to monitor technology is evolving, and driver refresher training can improve driver behaviour. in terms of keeping safety records, drivers can be trained and re-trained to reiterate why and how to use the features installed in the vehicles. Monitoring vehicles, managing performance, and maintaining vehicle utilisation to make informed decisions that improve efficiency and increase the safety and lifespan of fleet vehicles. From a safety and security point of view, the organization can effectively address the cause of future accidents and guarantee that drivers are not under pressure to take risks on the road by monitoring and controlling drivers more effectively.

Lack of resources: There is a lack of resources within the department; hence it impacts the entire process of monitoring alarm systems can be effective and more visible, alarms systems can be effective and more visible. Additional resources are required to monitor effectively.

Alerts and notifications: alerts help businesses to monitor fleet drivers in real time. The system does not carter a real-time alert in terms of roadside assistance. This category is required to minimise unnecessary administration work. The instability of the system is also a challenge. There are delays in sending alerts. System maintenance is a critical path, and there is a need for back-end system administrators to monitor system performance constantly.

The participant acknowledged that driver behaviour is a key part of operational and reputational management for business operations. It is particularly critical in fleet management and fleet industries, as implementing more effective and accountable driving practices could not only increase the organisation's bottom line but also inculcate far better safety. The participant further recommended that repetitive aggressive driver behaviour be monitored monthly. The highest number of violations to be escalated recommends refresher driver training and investigates whether it is driver-related (accident, fines, and maintenance) or vehicle-related (tracking etc.). If its driver related – recommend refresher training or the vehicle related referred to the workshop for repairs.

Objective 3: To make recommendations on fleet management framework solutions to improve effectiveness, productivity, and real-time analysis of monitoring vehicle utilisation.

This objective aimed at exploring possible solution, framework and make recommendations.

The study provided a comprehensive analysis of fleet management and a fleet management system and focused on the importance of technological advancement. The data set indicated minimal

incorporation of fleet management in eThekwini Municipality's fleet management system. It was evident that a gap was attached to the system's productivity. The underuse of effective monitoring of vehicle utilisation using a fleet management system verifies this. This was highlighted by the lack of implementation of the tool to enhance the system's productivity.

Technology development: The importance of research and development is a critical path in making progress in managing the organisational fleet. Here is a disconnect between the service provider and the requirements to be delivered per the specification. The challenge affecting monitoring vehicles is that vehicles are not reporting the current date and time, which impacts the service operation. Therefore, there is a lack of retrieving accurate data. Implementation of a effective backup system to produce real-time time data to assist users in terms of live monitoring, good reporting structure, which is more interactive in terms of departmental requirements, more robust system can be favourable to change management in terms of system advancements and technologies that keeping in line with the municipal requirements to ensure the efficiency of the service delivery to the eThekwini municipality communities.

IoT has emerged in recent years as one of the most significant 21st-century technologies. The use of IoT in fleet management enables fleet managers to follow daily operations, automate processes, gather crucial data, and know when to refuel (2022). Research companies have concluded that IoT appears to have strong development potential, and that international fleet operators are generally accepting of the technology. Drawing from the above literature participants were in support of system enhancement and implementation of GPS IoT platform to monitor vehicle utilisation in real time.

Participants have identified some of the “use cases” for the Fleet IoT platform model. The purpose for these cases are:

i To achieve value for money by optimizing use of vehicles.
ii Use the vehicle tracking data to identify gaps in service delivery and enhance service delivery.
iii To properly size the fleet using information on vehicle utilization and service delivery requirements.
iv Enhance driver behavior and performance to reduce operational expenses for vehicles.

Table 9: IoT Use Cases

Activity	Desired Outcome	Impact/Benefit
Live Monitoring of timeous service delivery using vehicle tracking data: There is no linkage between the service that is being delivered and the vehicle, therefore there is no live measuring of actual versus schedule. Any deviations from the schedule can only be identified by physical inspections or complaints from the customers. This is after the effect and is deemed as poor service delivery.	Linkage of service delivery schedule with vehicle tracking data. Timeous and Active monitoring and control of service delivery operations.	Effective monitoring of service delivery. Improved turnaround time Address the delays in service delivery timeously.
Real Time analysis of utilization of vehicles. There is no active tool of monitoring fleet utilization, as a result we are unable to reallocate non- and under-utilized vehicles on a real time basis. **Real Time analysis of Non utilization, Under Utilization and Over Utilization.** Currently, eThekwini Municipality solely track fleet utilization using data from the tracking system. This is after the fact, and there is no active method for figuring out non-use, under-use, and over-use based on operational needs and standards. **Real time analysis service delivery in the areas** There is no effective monitoring if the services are delivered within an area the vehicle is allocated to service (North, West, South or Central). Multiple vehicles can go back to attend the same	Possibility of real-time vehicle availability, non-utilised, under-utilised, and overutilised identification. Pre-planning of resources to achieve optimum utilization. Ability to monitor if services are delivered to areas as allocated and there is no unnecessary overlap, under or over servicing of areas. Development of optimum driving benchmarks per vehicle category and classification, which will enable us to compare driver performance against benchmarks and different drivers on similar routes.	Efficient and Effective Utilization of vehicles. Elimination of unproductive vehicle usage. Reduction of vehicles operating costs. Improve driver safety. Prolong vehicle life.

fault, there is no way of determining whether it's a repeat or a duplication. **Monitoring movements of vehicles** There is no way of analyzing vehicle movements across the areas or identifying if these movements are productive, dead, or unproductive kilometres. There is no real time alert for vehicles congregating at a common place. **Live Analysis of driver behavior** Driver scorecards from the vehicle tracking data are available after a trip and there is no pro-active monitoring of driver behavior.		
Active Determination and Monitoring of Vehicle Availability Manual methods of determining and recording of vehicle availability are used. This is derived from the total fleet size less (OTR) the number of vehicles that are in the workshop for repairs or maintenance and are not available for use by the Department. **Accurate and automated indication of vehicle availability at any given point in time.** There is no live analysis of vehicles that are available and vehicles that are not available (Out of Service) at given point in time. e.g., hourly, daily, weekly, monthly, and annually. Vehicles that are involved in accidents and breakdowns are not recorded timeously and only	Active identification and monitoring of vehicle that are available and not available.	Minimize costs of hiring vehicles. of Maximize opportunity costs underutilized vehicles

considered when the vehicle reaches the workshop or depot.		
Fleet size per Department per service area. The fleet is allocated per Department's requirements and per service area. The current fleet size could be under or oversubscribed and there is no tool to analyze whether the fleet size required per operation is at an optimum level.	Rightsizing of fleet.	Reduction of operating costs**.**

5.4 Limitations of the Study

The scope of the study was restricted to one division, which solely keeps an eye on eThekwini Municipality. The primary goal of this study was to draw a broad conclusion on the efficacy of effective monitoring and the effectiveness of fleet management system-based monitoring of vehicle utilisation.

5.5 Study Repercussions

The research findings in this study show that the current system is not stable; hence it requires system development or enhancement to ensure productivity and enables monitoring effectiveness of service delivery to communities timeously. The study results show critical factors affecting fleet utilisation monitoring using fleet management systems. The research findings clearly indicate the effects on the business and the corresponding repercussions when a real-time solution has been deployed. In general, the study analyzed the organizational impact of deploying a real-time solution.

The study findings demonstrate the need for contemporary fleet management solutions for the eThekwini Municipality to engage with fleet vehicles in real time and achieve high operational efficiency.

5.6 Summary of the study

The aim of the study was to determine whether the eThekwini Municipality can use an information technology, communication, and fleet management system, as well as to describe any challenges and noteworthy benefits of the system's effectiveness and efficiency in terms of monitoring to ensure productivity in service delivery to the eThekwini communities.

Chapter 1: In this chapter, the study goals and objectives are described in general terms. broad background of the research problem, importance of the study, and research questions. The chapter is organized in accordance with the study five objectives, which were as follows:

Chapter 2: The literature provided an extensive review of the existing fleet management information theories, examined the fleet management system's historical development, and described the research concepts—the importance of monitoring and the real-time monitoring benefits of monitoring vehicle utilisation.

Chapter 3: provided an explanation of the study methodology and research design. Firstly, the nature of this study, namely the mixed methodology, research paradigm, research strategies, target population, sampling, and exploratory approach, were detailed to understand the pro-active monitoring of vehicle utilisation using the Fleet management system. Mixed methodology, interviews and questionnaires were distributed to the focus group to collect rich descriptive data. The process is followed by data analysis, validity, reliability of the study, trustworthiness, and limitations. Lastly, the ethical considerations were presented.

Chapter 4: In this chapter 4, the data collection and analysis concentrated on collected data and its analysis.

5.7 Recommendations

This empirical study main finding is a demonstration of the advantages of adopting a contemporary fleet management system in transportation logistics. Therefore, the research's findings offered a rare chance to better understand the practical difficulties associated with effective fleet utilisation monitoring using a fleet management system as well as the chance to identify areas which, if exploited, could result in additional benefits as recommended below:

i Implementing a pro-active backup system to produce real-time data to assist users in live monitoring, a good reporting structure, which is more interactive in terms of departmental requirements, and a more robust system can be favourable.

ii Adapting innovative technology to improve system functionality and the ability to develop new, innovative approaches.

iii Implementation of GPS IoT platform to give departments (units) value-added information that can help line departments to improve planning, reduce abuse, minimise wasted trips and allocate resources appropriately.

5.9 Conclusion

This study analyses the effectiveness of monitoring vehicle utilisation using a fleet management system. The study was situated in eThekwini Municipality, City of Durban Central. The effectiveness and efficiency of the system performance are being defined. Also, a functional proposed solution for a fleet management system is presented. The objectives of the study were explained in-depth, resulting in the aim of the study being achieved. The system performance and value add are also defined in this study. The system functionality in terms of real-time, data integrity and effective monitoring of service delivery is described in this study. Recommendations from the respondents to improve system functionality are also outlined.

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ANNEXURE A

INTERVIEW QUESTIONS

Thank you for participating in this study. The objective of this research is to evaluate effective monitoring of vehicle utilisation using fleet management system of eThekwini Municipality in Durban KwaZulu Natal. Through your participation I Precious Nonhlanhla Tembe (the researcher) hope to gather information of your knowledge and experience in monitoring of vehicle utilisation and effectiveness of the Fleet Management System. The estimate time for this interview will be about 30 -60 minutes. The questionnaire will be anonymous, and confidentiality to all participants involved, and the organisation will be protected.

SECTION A – Biographical data

INSTRUCTIONS TO RESPONDENT
Unless instructed otherwise, please answer the following questions

1. Age Group

- ☐ 18 and below
- ☐ 26 – 45
- ☐ 46 – 57
- ☐ Over 57

2. **Is your participation in monitoring vehicle utilisation using FMS on a direct basis?**

Yes	No

3. **Numbers of years you have worked within the eThekwini Municipality.**

- ☐ 5 years and below
- ☐ 6 – 10
- ☐ 11 – 15
- ☐ 15 and above

SECTION B – Interview questions

Q1: What is your understanding of vehicle utilisation?

Q2: How is the fleet management system meant to assist eThekwini Municipality?

Q3: What are the main challenges in monitoring vehicle utilisation using the fleet management system at eThekwini Municipality?

Q4: What do you understand about efficiency?

Q5: Why is Efficiency important in eThekwini Municipality?

Q6: What factors affect the monitoring of vehicles using a fleet management system?

Q7: Are there any concerns regarding effective measures that the system should include in improving productivity?

Q8: What are the effects of driver management in eThekwini Municipality?

Q9: What is your understanding of the fleet management system?

Q10: Why is a fleet management system important?

Q11: What are the causes and effects of the poor fleet management system at eThekwini Municipality?

Q12: What measures can be taken to increase the fleet management system's efficiency to improve productivity?

Q13: Why is adapting innovative technology necessary for efficiency in service delivery at eThekwini Municipality?

ANNEXURE B

LETTER OF INFORMATION

Title of the Research Study: The Effectiveness of Pro-active Monitoring of Vehicle Utilisation in eThekwini Municipality Fleet Management Systems.

Principal Investigator/s/researcher: Precious Nonhlanhla Tembe, National diploma in Marketing and Bachelor of Technology in Marketing.

Co-Investigator/s/supervisor/s: Izekiel Nohumba, PhD Specialising in Management Science

Brief Introduction and Purpose of the Study:

Good day and thank you for participating in the study. My name is Precious Nonhlanhla Tembe, and I am a student at the Durban University of Technology. I am presently conducting a research study for my dissertation titled: The Effectiveness of Pro-active Monitoring of Vehicle Utilisation in eThekwini Municipality Fleet Management Systems. The research study of eThekwini Municipality in Durban KwaZulu Natal. This letter is an invitation to participate in this study. The study aims to evaluate the effectiveness of effective monitoring of vehicle utilisation in the eThekwini Municipality Fleet Management System. The study main purpose is to establish the feasibility of using evolving information technology, communication, and fleet management systems at eThekwini Municipality. Explain possible obstacles and any significant advantages of implementation effectiveness and efficiency of the system in terms of monitoring to ensure productivity in service delivery to the eThekwini communities.

Outline of the Procedures: Fleet management is the function that oversees, coordinates, and facilitates various transport and transport-related activities. This study covers vehicles involved in

in-service delivery, the management of light and heavy vehicle fleets and plant and equipment used as a mode of transportation. The study aims to evaluate the effectiveness of Pro-active Monitoring of Vehicle Utilisation in eThekwini Municipality Fleet Management Systems. The objectives of the study are:

- To evaluate the efficiency of effective monitoring of vehicle utilisation eThekwini Municipality's fleet management system in Durban.
- To evaluate eThekwini Municipality's fleet management system's performance, efficiency, and productivity.
- To evaluate the driver performance and driver behavioural patterns to minimise operating costs.
- To identify the effects of the poor Fleet Management System at eThekwini Municipality.
- To make recommendations on fleet management framework solutions to improve effectiveness, productivity, and real-time analysis of monitoring vehicle utilisation.

The participant is expected to complete the questionnaire at his or her convenience. The questionnaire will be distributed or forwarded via email. The questionnaire will be anonymous, and the confidentiality of all participants and the organisation will be protected. The estimated time to complete the questionnaire will be about twenty (20) minutes. The interviews will be tape-recorded.

Risks or Discomforts to the Participant: No anticipated or foreseen risks or discomforts to the participants.

Explain to the participant the reasons he/she may be withdrawn from the Study: Participation in this study is entirely voluntary. The participant will be advised that he/she is permitted to withdraw participation from the study for any circumstances. Termination or withdrawal can be done via email since all participants can access the email platform.

Benefits: Once the information is gathered from the participants, recommendations can be shared with the organisation to evaluate system performance and consider the proposed model.

1. The research dissertation will be published for students and placed in public libraries and other educational institutions, i.e., DUT.

2. It will encourage municipalities, transport industries and other organisations to adopt innovative technologies in terms of fleet management.

Remuneration: There will be no remuneration given to participants for participating in the study. Although we cannot offer participants any compensation, we can provide participants with a copy of the results from the study.

Costs of the Study: Participants will not be expected to cover any costs towards the study. The Durban University of Technology fully covers the costs of the study.

Confidentiality: The interview questions and questionnaires will remain anonymous, and the confidentiality of all participants involved will be reserved, kept safe and inaccessible, and the organisation will be protected throughout the study.

Results: The researcher intends to share the study results with the municipality.

Research-related Injury: In any event of a research-related injury or adverse reaction, the participant will compensate by the researcher.

Storage of all electronic and hard copies, including tape recordings: All the hard copies will be stored securely in a locked file cabinet, and the electronic copies will be stored in a laptop with a password.

Persons to contact in the Event of Any Problems or Queries: (Supervisor: Izekiel Nohumba, 0645424608, e.nohumba@gmail.com) Please contact the researcher (081524559), my supervisor (0645424608) or the DUT-Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Acting Director: Research and Postgraduate Support at researchdirector@dut.ac.za

ANNEXURE C

CONSENT

Full Title of the Study:

Names of Researcher/s:

Statement of Agreement to Participate in the Research Study:

- ☐ I hereby confirm that I have been informed by the researcher, Precious Nonhlanhla Tembe, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: **20170310**_,
- ☐ I have also received, read, and understood the above written information (Participant Letter of Information) regarding the study.
- ☐ I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- ☐ In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- ☐ I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- ☐ I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

□ I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, (Name of researcher) herewith confirm that the above participant has been _____ fully

informed about the nature, conduct and risks of the above study.

Full Name of Researcher	**Date**	**Signature**

Full Name of Witness (If applicable)	**Date**	**Signature**

Full Name of Legal Guardian (If applicable)	**Date**	**Signature**	**Signature**

ANNEXURE D

DUT DURBAN UNIVERSITY OF TECHNOLOGY

Faculty of Management Sciences
Department of Entrepreneurial Studies and Management
Durban
4000

EThekwini Municipality
City Fleet Unit
102 Johannes Nkosi Street
Durban
4000

25 May 2021

The Head City Fleet RE: Permission to Conduct Research Study

I hereby request permission to conduct a research study at your organization (eThekwini Municipality – City Fleet Unit). I am currently enrolled in Master of Management Science: Business Administration at Durban University of Technology, and am in the process of writing my Master's dissertation.

The topic is" The Effectiveness of Pro-active Monitoring of Vehicle Utilization in eThekwini Municipality Fleet Management Systems". It is my wish that eThekwini municipality allow me to conduct a research to forty participants from the department of City Fleet Unit and to other participants who utilises the system.

The survey results will be pooled for the dissertation and individual results of this study will remain confidential and anonymous. Should this study be published, only pooled results will be documented. Participation is voluntary, no costs will be incurred by either the organization or the individual participants and they will suffer no physical harm by participating in the surveys.

Your approval to conduct this study will be greatly appreciated.

Yours Sincerely,

Precious Nonhlanhla Tembe

13 / may / 2021

Signature Date

13 May 2021

Date