OPTIMISING LAND TRANSPORT RESOURCES: IMPROVING FLEET MANAGEMENT USING COST EFFICIENCY EFFECTIVENESS

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UNIVERSITI UTARA MALAYSIA

AUGUST 2024

OPTIMISING LAND TRANSPORT RESOURCES: IMPROVING FLEET MANAGEMENT USING COST EFFICIENCY EFFECTIVENESS

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Thesis submitted to

College of Business,

Universiti Utara Malaysia,

in fulfilment of the requirement for the Master of Science in

Transportation and Logistics Management

Kolej Perniagaan
(College of Business)
Universiti Utara Malaysia

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Tajuk Tesis / Disertasi
(Title of the Thesis / Dissertation) : **Optimising Land Transport Resources: Improving Fleet Management Using Cost Efficiency Effectiveness**

Program Pengajian
(Programme of Study) : **Master of Science (Transportation & Logistics Management)**

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Abstrak

Dalam konteks dinamik geopolitik yang semakin berkembang dan kekangan kewangan, mengoptimumkan sumber pengangkutan darat menjadi amat penting bagi Tentera Udara Diraja Malaysia (TUDM). Kajian ini meneroka strategi bagi meningkatkan pengurusan fleet melalui kecekapan kos dan keberkesanan. Kajian ini meneliti penggunaan teknologi canggih seperti telematik, kecerdasan buatan (AI), dan Internet Segalanya (IoT) untuk meningkatkan kecekapan operasi dan mengurangkan kos. Ia mengenal pasti cabaran operasi utama, termasuk pengagihan kenderaan yang tidak cekap, keterbatasan kemampuan penjejakan masa nyata, dan amalan penyelenggaraan yang reaktif. Selain itu, kajian ini menilai program latihan semasa untuk anggota TUDM untuk memastikan mereka dilengkapi secukupnya dalam menguruskan sistem pengurusan fleet moden dengan berkesan. Dengan menganalisis faktor dalaman dan luaran yang mempengaruhi penggunaan fleet, kajian ini memberikan panduan yang boleh dilaksanakan oleh TUDM bagi meningkatkan kesiapsiagaan operasi dan keupayaan strategik mereka disamping mengatasi kekangan kewangan. Dapatan ini bertujuan untuk menyokong pembangunan sistem pengurusan fleet yang lebih mantap dan kos efektif yang selaras dengan misi TUDM untuk mengekalkan keselamatan negara dan menyumbang kepada kestabilan serantau.

Kata Kunci: *Pengurusan fleet, sumber pengangkutan darat, kecekapan kos, keberkesanan, telematik, kecerdasan buatan, Internet Segalanya, cabaran operasi, program latihan.*

Abstract

In the context of evolving geopolitical dynamics and budget constraints, optimizing land transport resources has become crucial for the Royal Malaysian Air Force (RMAF). This study explores strategies to enhance fleet management through cost efficiency effectiveness. The research investigates the application of emerging technologies such as telematics, artificial intelligence (AI), and the Internet of Things (IoT) to improve operational efficiency and reduce costs. It identifies key operational challenges, including inefficient vehicle allocation, limited real-time tracking capabilities, and reactive maintenance practices. Additionally, the study evaluates the current training programs for RMAF personnel to ensure they are equipped to manage modern fleet management systems effectively. By analysing both internal and external factors impacting fleet utilization, this research provides actionable insights for the RMAF to enhance its operational readiness and strategic capabilities while navigating financial constraints. The findings aim to support the development of a more agile, cost-effective fleet management system that aligns with the RMAF's mission to maintain national security and contribute to regional stability.

Keywords: *Fleet management, land transport resources, cost efficiency, effectiveness, telematics, artificial intelligence, Internet of Things, operational challenges, training programs.*

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my supervisor, Associate Professor Ts. Dr. Nur Khairiel bin Anuar, for his invaluable guidance, insightful comments, and unwavering support throughout the duration of this research. His expertise and encouragement have been instrumental in shaping this paper.

I am also deeply thankful to all my friends and colleagues at Universiti Utara Malaysia who have shared their knowledge, provided feedback, and offered their assistance whenever needed. Your camaraderie and intellectual exchange have enriched my research experience.

Last but not least, I extend my heartfelt appreciation to my family for their endless love, understanding, and patience during this journey. Their support has been a constant source of strength and motivation.

This research would not have been possible without the contributions and support of these individuals and institutions. Thank you all sincerely.

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LIST OF ABBREVIATIONS

HCI Human Computer Interaction

GPS Global Positioning System

IoT Internet of Things

OiC Officer in Charge

RMAF Royal Malaysian Air Force

SNCO Senior Non-Commissioning Officer

SOP Standard Operation Procedure

TAM Technology Acceptance Model

CHAPTER 1

INTRODUCTION

1.0 Background of the Study

In recent years, the geopolitical landscape has undergone significant transformations, necessitating a more agile and responsive military force. Fleet management, an approach used by administrations and companies to organize and coordinate work vehicles, is crucial for the Royal Malaysian Air Force (RMAF) to maintain cost efficiency and technological advancement. Optimizing land transport is essential to reduce costs and delivery times associated with transport (6W Research, 2023). The RMAF, facing a dynamic security environment, requires a robust and optimized fleet management system to ensure the rapid and effective deployment of its assets (Masdan et al., 2023). The complexity of modern military operations demands seamless integration of air and ground capabilities, making efficient land transport critical for overall effectiveness.

The successful execution of joint operations often hinges on the synchronized movement of personnel and equipment. Modern military operations require coordination between air and ground capabilities, with RMAF's security being a primary concern for Malaysia's government and air force. Fleet management reduces operational costs and enhances overall security, ensuring rapid and effective deployment of assets to meet strategic and tactical objectives (Otey, 2006). In the contemporary security landscape, integrating air and ground capabilities is paramount for mission success (Hinman & Jahn, 2016). The RMAF must enhance interoperability between air assets and land transport resources through integrated command and control (C2) systems, standardized communication protocols, and joint training

exercises. C2 systems are crucial for coordinating operations, facilitating real-time data sharing, decision-making, and resource allocation across diverse operational domains. Advanced analytics, artificial intelligence, and machine learning within these systems enable commanders to swiftly identify patterns, anomalies, and potential threats, making informed decisions to adapt strategies and allocate resources efficiently.

Budget constraints and the need for resource optimization pose significant challenges to military fleet management (Amouzegar, Tripp, & Galway, 2004). The RMAF must balance operational needs with financial limitations, ensuring efficient resource utilization without compromising safety or performance (Mohsan et al., 2023). This involves scrutinizing current practices, identifying inefficiencies, and implementing strategic improvements, such as prioritizing investments in maintenance, training, and technology upgrades while eliminating redundancies and reducing operational costs. A proactive approach to fleet management can enhance the RMAF's operational capabilities within budgetary constraints.

The evolving security landscape and economic constraints necessitate a re-evaluation of fleet management practices by the RMAF. Rapid deployment and seamless integration of air and ground capabilities underscore the critical role of a robust fleet management system in ensuring mission success and operational efficiency. Such a system facilitates swift vehicle mobilization, resource coordination, and real-time fleet activity monitoring, enabling effective responses to dynamic security threats and operational requirements. By optimizing asset utilization, enhancing communication between air and ground units, and providing comprehensive visibility into fleet operations, a robust fleet management system

enhances operational readiness and agility in complex security environments (Voss M.D., Whipple J. M., & Closs D. J., 2009).

To address these challenges, the RMAF must implement a comprehensive and adaptive fleet management system (Chai et al., 2024). This system should enable rapid deployment and coordination, while addressing diverse fleet composition, maintenance complexities, driver behaviour monitoring, and regulatory compliance. Leveraging advanced technologies, strategic resource allocation, and continuous process optimization can ensure cost-effective operations, enhanced safety, and operational excellence in the face of evolving security dynamics and economic constraints (Sallam, Mohamed, & Mohamed, 2023). Effective resource allocation and cost-effective operations are imperative for enhancing operational capabilities, strengthening national security, and ensuring efficient use of public resources.

The RMAF is a critical component of Malaysia's national defence, tasked with safeguarding the nation's airspace, supporting ground operations, and contributing to regional and international security efforts. Its operational capabilities rely on advanced aircraft, skilled personnel, and an efficient, well-maintained fleet of land transport resources (“Defense Technical Information Center,” 2000). These resources are essential for transporting personnel, equipment, and supplies and providing crucial support in various operational scenarios.

Improving fleet management provides operational insights that inform strategic choices and aggregate vehicle data for the RMAF. Effective fleet utilization serves as a baseline management tool, including vehicle capacity information. Improved fleet management is vital for addressing security-related challenges faced by the RMAF (Syed Mustapa et al., 2020). Comparing current data with previous data

is necessary to identify areas for improvement in fleet management and vehicle utilization within the RMAF.

The integration of the RMAF's fleet of aircraft and land transport resources is pivotal in executing its mandate and enhancing Malaysia's defence and security landscape. These assets enable the RMAF to effectively carry out missions, from surveillance and reconnaissance to transport and logistical support. Maintaining a robust and well-equipped fleet strengthens the RMAF's operational capabilities and reinforces its role in regional security initiatives. Continuous modernization and efficiency efforts underscore the RMAF's proactive stance in adapting to evolving security challenges, ensuring it remains a key player in safeguarding Malaysia's interests and contributing to regional stability and defence cooperation (Syed Mustafa et al., 2020).

This research aims to delve into the intricacies of the RMAF's land transport resources and their management, providing a comprehensive understanding of the challenges faced and opportunities for improvement. By doing so, it seeks to contribute valuable insights that can bolster the RMAF's overall operational readiness and strengthen its role as a guardian of national security.

1.1 Problem Statement

The RMAF encounters substantial hurdles in effectively managing and optimizing its land transport resources, a critical component of its operational capabilities. Presently, the allocation of vehicles within the fleet lacks efficiency, leading to underused assets and overburdened others, thereby compromising the overall readiness of the RMAF. Real-time tracking and visibility into the location and condition of vehicles are limited, impeding the timely decision-making process. This deficiency not only affects the

RMAF's ability to respond promptly to operational needs but also hampers the proactive scheduling of maintenance activities, contributing to increased downtime (Yaacob, 2023).

The RMAF has been steadfast in its commitment to ensuring a well-equipped and efficient transport fleet, despite facing significant financial challenges and budget constraints. These constraints have posed obstacles to the RMAF's ability to maintain optimal management and readiness of its land transport resources, impacting its operational capabilities. Efforts to address maintenance issues and enhance capabilities have been hindered by limited financial resources, leading to difficulties in modernizing assets promptly and ensuring the operational readiness of existing resources. The RMAF's struggle to balance the need for modernization with financial limitations underscores the complex landscape it navigates in striving to uphold its operational efficiency and effectiveness.

Despite the financial hurdles and budget constraints, the RMAF continues to navigate a challenging environment to enhance its capabilities and address maintenance issues within its land transport resources. The RMAF's focus on modernization under the RMAF Capability Development Plan 2055 (CAP55) reflects a strategic approach to balancing operational needs with financial realities. As the RMAF grapples with limited financial resources, strategic decisions on asset management and acquisition become crucial to ensuring sustained operational readiness and effectiveness in fulfilling its mandate of safeguarding Malaysia's security and contributing to regional stability (RMAF Air Power Manual, 1995).

Maintenance practices within the current framework tend to be reactive rather than preventive, resulting in higher operational costs and a potential reduction in the lifespan of vehicles. The absence of a comprehensive strategic plan for fleet

management exacerbates these challenges, leaving the RMAF vulnerable to operational disruptions and hindering its ability to meet mission objectives effectively (Global, 2020). Another concern is ageing land vehicles in the RMAF inventory. Managing ageing land vehicles in the RMAF fleet is a critical aspect of operational readiness and efficiency. The important of transportation in terms of logistics support includes transporting men, weapon and armoury, material and food in supporting the military operation in the field (Bohannon, K. S. ,2018). With a good route planning, it will give impact on the shortest time travel and the objectives of logistics support can be achieved. This is also supported by good vehicle condition. As vehicles approach or exceed their expected service life, several challenges arise that must be addressed. Firstly, maintenance costs escalate significantly as vehicles age. Components wear out more frequently, necessitating costly repairs and increasing operational expenses. Moreover, ageing vehicles become less reliable, prone to breakdowns that can disrupt logistics and deployment schedules crucial for military operations.

Compounding these issues are budgetary constraints, which demand a more judicious allocation of resources. Inefficient fleet management practices contribute to unnecessary expenditures, diverting funds from critical areas of defence and national security (Gholz & Sapolsky, 2000). Addressing these challenges is not only crucial for the RMAF's operational readiness but also for ensuring responsible use of public funds.

Countries all across the globe are increasing their focus on modernising their military by integrating advanced technologies such artificial intelligence (AI) and Internet of Things (IoT). For instance, the US military has asked for around 1.8 billion against the integration of AI into their military systems from the US government (Singh, 2024). China, on the other hand, is investing around 1.6 billion annually for

developing AI-enabled systems. The incorporation of such digital technologies can help improve the military systems. With the use of IoT, it can be possible to have information about military vehicles and fleets in real-time. In short, tracking and monitoring of military equipment can be easy through integration of IoT technology.

AI, on the other hand, can be used for predictive maintenance. AI technology is used by businesses for predictive maintenance (Ye, Yong & Han, 2020). The integration of AI with a system can indicate when maintenance of a particular hardware is needed. Countries are needed to stay prepared with all the military equipment to deal with any uncertain situation or emergencies. Hence, it is essential that all the military hardware, vehicles and fleets are ready for combat. The operations of an army may be impacted due to poor maintenance of military hardware. In this case, the application of AI can be effective to deal with the situation.

Apart from IoT and AI, telematics is another technology that can be used by RMAF to improve its practices. In telematics, telecommunication and information technology are used for improved communication. The concept of telematics is used for vehicles. In other words, multiple technologies such as Global Positioning System (GPS) and wireless technologies are integrated for faster transmission of information among different devices. It can be possible to track speed and location of vehicles using telematics (Young et al. 2020). On top of this, it is possible to identify maintenance requirements for vehicles using telematics.

1.2 Research Questions

a. What emerging technologies, such as telematics, AI, and IoT, can be utilized to enhance the efficiency of land transport operations for the RMAF?

b. What are the key operational challenges faced by the RMAF in managing and utilizing its land transport resources effectively?

c. What strategies can the RMAF implement to ensure that its personnel are adequately trained to handle the complexities of modern fleet management systems?

1.3 Research Objectives

a. Investigate appropriate technological solutions that can enhance fleet management, including telematics, AI, and IoT.

b. Examine external and internal operational factors affecting vehicle utilization.

c. Evaluate the effectiveness of current training programs within the RMAF for land transport resource management.

1.4 Scope of the Study

This study is essential for highlighting the importance of fleet management in optimizing vehicle utilization within the RMAF. Continuous improvement in the transport system is vital for maintaining national security and operational efficiency. This research will provide detailed information about the RMAF's land transport resources, offering insights into the strategies implemented by the government to enhance fleet management. The study will investigate appropriate technological solutions, such as telematics, AI, IoT, predictive maintenance systems, and real-time tracking, to improve the efficiency and effectiveness of fleet management.

Furthermore, the research will analyze key operational factors, both internal and external, affecting the utilization and management of land transport resources within the RMAF. It will also explore current training programs for RMAF personnel, assessing their effectiveness and identifying areas for improvement to ensure proficiency in modern fleet management systems and technologies. Given the unstable geopolitical landscape, enhancing the security system is crucial, and this study aims to provide valuable insights into the necessary steps taken by the government to improve fleet management across all sectors of the RMAF and the broader national security framework.

1.5 Significance of Study

The significance of this study is multi-faceted, with direct implications for the RMAF and broader strategic considerations. Firstly, the research addresses critical challenges in land transport resource management within the RMAF, aiming to enhance operational efficiency. By identifying and mitigating inefficiencies in fleet allocation, maintenance practices, and technological integration, the study contributes to a more agile and responsive military force capable of meeting dynamic security challenges effectively.

Secondly, the optimization of fleet management practices proposed in this research aligns with budgetary constraints faced by military organizations. Through proactive maintenance strategies and the incorporation of modern technologies, the RMAF can achieve cost savings and ensure responsible resource allocation. This financial prudence is essential for sustaining military capabilities while navigating resource limitations (Services, 2024).

The study will be focused on the both external and internal factors that are related to the utilisation of the land transport resources. That is the reason the study will be helpful to provide the information about the requirement of the RMAF in any mission. The effectiveness of the training program that is taken in the recent time helps to understand the function of the fleet management. Different training programs that is included in the RMAF in terms of improving fleet management (Zuber, 2021). The government of Malaysia and RMAF need to look after the challenges related to the feet management which is necessary for reducing the issues and promoting more benefits.

1.6 Definition of Terms

To ensure clarity and understanding, the following key terms are defined as they are used throughout this study:

Fleet Management: The administration of a fleet of vehicles, including the processes and technologies used to manage and coordinate the operations, maintenance, and logistics of a fleet to enhance efficiency and reduce costs (Monnerat et al., 2019).

Telematics: The integration of telecommunications and information technology to provide real-time data on vehicle location, speed, fuel consumption, and other critical metrics. It is used to improve communication and operational efficiency (Said et al., 2016).

Artificial Intelligence (AI): The simulation of human intelligence in machines that are programmed to think and learn (Hassani et al., 2020). In the context of this study,

AI refers to systems and technologies that can predict maintenance needs, optimize routing, and improve decision-making processes in fleet management.

Internet of Things (IoT): A network of physical devices connected through the internet, enabling them to collect and exchange data. In fleet management, IoT can monitor vehicle conditions and performance in real-time (Ushakov et al., 2022).

Predictive Maintenance: A proactive maintenance strategy that uses data analysis and AI to predict when a vehicle or equipment will require maintenance, thereby preventing unexpected breakdowns and extending the lifespan of the asset (Ucar et al., 2024).

Command and Control (C2) Systems: Integrated systems used by military organizations to coordinate and manage operations, ensuring seamless communication and real-time data sharing between air and ground units (Blasch & Bélanger, 2016).

Operational Efficiency: The ability to deliver optimal performance with the least waste of resources, ensuring effective and efficient operations within the organisation (McLafferty Kevin, 2016).

Resource Optimization: The strategic allocation and use of resources to maximize efficiency and effectiveness while minimizing costs and waste (Rezaee & Pooya, 2019).

Operational Readiness: The state of being fully prepared to perform missions and tasks, with all necessary resources, equipment, and trained personnel available and functioning (Fletcher & Wind, 2013).

1.7 Organization of Thesis

Chapter one of the thesis consists of the general introduction which includes; the background of study, the statement of the problem, the research questions, significance of the study, the scope of study and the organization of the study. This chapter also defines key terms related to fleet management and vehicle utilization in the RMAF, emphasizing the importance of optimizing land transport resources to enhance operational readiness and efficiency.

Chapter two reviews existing literature on fleet management and vehicle utilization, particularly within military contexts. The literature review also explores challenges faced by military organizations in maintaining and optimizing their fleet resources. Chapter three outlines the methodology used in this study. It includes an explanation of the research design, the selection of the study area and the design of the questionnaire. The chapter also describes the sampling methods and data collection techniques employed, ensuring a comprehensive approach to gathering relevant data on fleet management and vehicle utilization in the RMAF.

Chapter four presents the findings and discusses the main issues identified from the data collected. The analysis focuses on the effectiveness of current fleet management practices, the impact of emerging technologies on vehicle utilization, and the challenges faced by the RMAF. The chapter also examines operational, financial, environmental, and security risks associated with fleet management and offers insights into potential improvements. Chapter five provides a summary of the research findings

and offers recommendations to address the identified issues. The chapter highlights the significance of the research and its contributions to improving fleet management in the RMAF. It also suggests potential directions for future research and provides practical recommendations for enhancing vehicle utilization and operational efficiency within the RMAF.

1.8 Chapter Summary

This Chapter emphasizing the critical role of efficient fleet management in maintaining operational readiness amidst a dynamic geopolitical landscape. It outlines key challenges, including inefficient vehicle allocation, limited real-time tracking, and budgetary constraints, which hinder the RMAF's effectiveness. The chapter also presents the research questions and objectives focused on exploring technological solutions and assessing training programs for land transport resource management. It highlights the study's significance in improving operational efficiency and responsible resource allocation. Key terms related to fleet management are defined for clarity, and the organization of the thesis is detailed, outlining the structure of subsequent chapters.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter discusses the definition and concept variables, previous study, hypothesis development, theoretical framework and underpinning theory. Effective fleet management and vehicle utilization are pivotal in ensuring that the RMAF can successfully conduct all training and operational activities. Fleet management encompasses a range of activities, including vehicle acquisition, maintenance, driver management, and compliance with regulations. By optimizing these components, fleet management aims to maximize the efficiency and cost-effectiveness of vehicle use. Vehicle utilization, on the other hand, focuses on the extent to which the fleet's vehicles are used efficiently, considering factors such as vehicle availability, operational time, mileage, and route efficiency. Research indicates that integrating advanced technologies like GPS tracking and telematics, coupled with predictive maintenance, can significantly enhance fleet performance by providing real-time data for better decision-making and reducing downtime and maintenance costs.

2.1 Definition of Cost Effectiveness Efficiency of Fleet Management

Fleet management is important to maintain the cost in terms of using the vehicle. Improvement of the fleet management is necessary to improve the technologies in the context of vehicles used by the RMAF and the security system. Despite challenges like rising costs and regulatory requirements, effective fleet management offers opportunities to streamline operations, minimize environmental impact, and enhance overall fleet performance. Continuous improvement in these practices is crucial for

achieving organizational goals and maintaining competitiveness in fleet management (Kinnunen et al., 2019). On the other hand, it involves the facts related to optimising efficiency and minimising costs and risks. In the viewpoint of Redmer (2022), fleet managers need to manage the costs, decreasing the risk of fleet vehicles and also need to manage the profitability. Effective fleet management provides advantages related to fuel savings, increasing customer service and many more. Fleet management helps to get real time visibility that includes software. In terms of getting historical data and the real time visibility operation helps to take more effective data driven decisions. Improving safety, minimising cost and increasing efficiency is the main aspect of fleet management (Tywoniak et al. 2009).

GPS vehicle tracking solution is important for maintaining the safety of the nation and the safety of the military forces. In terms of reducing the fuel cost fleet management plays an important role. The strategies of the management including the GPS trackers are helpful for reducing the cost of the fuel. As mentioned by Chen et al. (2021), the companies have started to use GPS trackers in the product to control the fuel cost. Fleet management strategy is helpful for managing the cost and risk in an effective manner. Improvement of fleet management is necessary to increase the efficiency of utilising the vehicle and increasing the security as well. The organisation can store the data related to the drivers and the location of the vehicle which ensure the safety of the people and also helpful for monitoring the traffic. Fleet management provides extra advantage when it is used in an effective way. The other benefits of fleet management are to increase productivity in terms of managing vehicles.

By reducing idle time and improving the tracking of the assets is important to increase the efficiency. Incorporation of robust telematics software could enhance the performance and productivity in terms of maintaining the efficiency of the employees.

According to Mehmood (2021), fleet management is also important to improve customer satisfaction. It helps to enhance the activity of the employees and the organisation as well. Fleet management is necessary to manage the delivery and the cost management. Reducing the travel time and reduction of the risk is highly influenced by fleet management. GPS tracking is one of the most important parts of fleet management and improvement of this management helps to grow the performance of employees. GPS tracking is a thing that can provide solutions for each thing and it helps to maintain the risk factors and security of an organisation. Tracking real-time location of the drivers are helpful for the fleet managers in terms of maintaining reports of the drivers and also maintaining the security of the national security force (Martin Dodge & Rob Kitchin, 2007).

2.1.1 Factors Affecting Cost Effectiveness Efficiency

The factors that affect the cost effectiveness efficiency of the of fleet management are efficiency in operations, reducing cost, decision-making that are driven by data, proactive maintenance and the ethos that are customer-centric (Hindarto, 2023). These factors need to be maintained to maintain the efficiency of the fleet management. Data-driven decision making is necessary for making the right decision and increasing work efficiency. As per Wu et al. (2021), decision making is one of the most important parts that ensure the improvement of the fleet management system. The effective way of vehicle utilisation is important to reduce the cost, reduce the risk and many more. Managers need to make decisions based on the data which help to make the right decision and also helpful for application of the strategies in the correct manner. Data and the software are the part of the advanced fleet management. Cost reduction is the

main aspect as it reduces the cost of the vehicle and effective strategies help to maximise the security.

In terms of proactive maintenance, effective fleet management has a great impact. Maintaining the schedules related to the usage of vehicles, and costly repair affects the efficiency of the fleet management (Carter, 2024). Reducing the repair cost of the vehicle and extending the longevity of the vehicle can be increased by improving fleet management. The strategies of fleet management help to reduce the impact of such factors and help to increase the efficiency of work. Effective fleet management is also necessary to reduce downtime of vehicles. In the viewpoint of Ivanova, (2022), customer-centric ethos is another important factor that can affect the fleet management system. Customer satisfaction increases the efficiency rate of fleet management (Zelenka, 2022). The strategies of fleet management related to customer satisfaction are able to improve fleet management. High quality survives to maintain the brand reputation and increase the level of the brand in terms of maintaining security and reducing risk from RMAF.

Timely delivery and the quick response to the quality increase the reliability of the brand also increase the reputation of the brand. In the present era, geopolitical imbalance shows the security related issue and the instability in the international defence industry create problems for the different countries (Daugherty, 2024)

Improvement of fleet management is necessary to handle such problems and enhance the situation. The factors that influence the efficiency of the fleet management need to be controlled and handled with the right strategies. The strategies of fleet management are quite effective to reduce the risk and also for managing the data related to the vehicle. As mentioned by Meissner, Rahn & Wicke (2021), proactive maintenance and the cost reduction is the most important for maintaining the activities

of fleet management. The countries are adopting fleet management tools and technologies for maintaining the security of the nations. The most useful tool is GPS tracker that influences the location tracking of the drivers and maintaining record of the drivers for safety purposes (Davor Vujanovic, 2012).

2.1.2 Issues in cost effectiveness efficiency

The issues of the cost effectiveness fleet management are raising fuel costs, inefficiency in operations, management of the drivers and compliance, integration of new technologies and environmental concern (Leigh, 2024). Unforeseen maintenance demand and customer satisfaction create issues in terms of cost-effectiveness of fleet management. Fluctuating price of the fuel increases the issues for the fleet managers (Stainforth, 2022). In recent days, an increasing war situation and unstable political relations between the countries creates the issue related to the increasing cost of the fuel. According to Bruzzone, Cavallaro & Nocera (2021), operational inefficiency is another important factor that creates challenges for fleet management. Fleet managers focus on factors like operational efficiency, driver management and many more. Delay of application of the strategy and underutilization of the assets has a direct effect on the satisfaction of the customer that creates issues for the fleet management. In the present era, technological development increases the demand of the technologies in the fleet management process (Gayialis et al., 2022). The software and the technologies that are used by the fleet managers are necessary for increasing the work efficiency of the fleet managers.

Fleet management is a broad area and it includes huge responsibilities, technological development helps to increase the efficiency of fleet management. In terms of dealing with the external and internal effect the fleet management needs to

be improved with the requirement of the time and situation. In the viewpoint of Yue et al. (2020), environmental concern is one of the big issues for the management. Eco-friendly practices are necessary for managing the responsibilities of fleet management. The practices that are eco-friendly involve additional costs that are quite challenging for the fleet management in terms of managing the cost and budget. Unexpected breakdown of the vehicle involved the additional repair cost which has been quite high and created challenges for the managers. These issues lead to the loss of productivity and the revenue. Poorly planned routes delay the delivery and decrease the performance efficiency (Shigang Chen & K. Nahrstedt, 1998). The challenges of fleet management can be maintained by using the effective strategies that include technological incorporation, effective strategies of the management and maintain efficiency in the operation process.

The issues of fleet management are big and necessary to be handled. Optimisation of fleet management is important to reduce the challenges of fleet management (Iwan et. at. 2018). In the context of security concern, vehicle utilisation is most important by using the right ways. Maintaining the assets and increasing the life of the parts of the vehicle can reduce the cost and make the situation easy for fleet managers. According to Cruz & Sarmento (2020), by increasing the efficiency of the delivery management platform, fleet management can reduce the impact of the factors that create issues. Challenges are a part of the management and it is the responsibility of the management to handle the issue by reducing the impact of external and internal factors. Incorporation of technologies improves the decision-making ability that is more data based and the development of the performance is helpful for providing satisfaction to the customers. The effective strategies help fleet managers to increase their work efficiency (Mehmood, 2021).

2.2 Definition of Operational Challenges

Operational Challenges in vehicle fleet management encompass a range of critical variables that are essential for optimizing operational efficiency and performance. In operational it can define as obstacles or difficulties faced in the routine management of land transport resources. These challenges include vehicle maintenance, routing, scheduling, fuel management, driver behaviour, and regulatory compliance (Solutions, 2023) Effectively managing these operational challenges is crucial for minimizing costs, maximizing productivity, ensuring safety, and meeting service level agreements. By addressing these variables proactively and implementing strategic solutions, fleet managers can enhance overall fleet performance and achieve greater success in their operations.

2.2.1 Theory Associated with Operational Challenges

The theories such as business process redesign, lean manufacturing reconfiguration and the theory of six-sigma are associated with the operational challenges. These theories are described about the effective operations which can help the managers to manage the utilisation of the vehicles and also it is important to improve the operational challenges that can overcome by the managers. Managing resources and the raw materials are the responsibilities of the operational management and with the help of these theories operational management can improve with the efficiency. In the viewpoint of Fehrer et al. (2022), business process redesign includes the analysis of workflow and structure of the working pattern of the employees. This theory is important for improving the structure of the organisation and redesigning the working process of the organisation. The concept of lean manufacturing involves the reduction

of the cost by decreasing waste. In terms of managing the workload and managing the value creation in the organisation, the concept of lean manufacturing is helpful.

The other theory such as six-sigma focuses on the quality of the performance of the organisation and also includes the analysis of the performance rate of the employees. It is important for operational management to overcome the challenges related to the responsibilities of the operational management. Adoption of the six-sigma method in the operational management provides the opportunities to increase the work efficiency of the operational management. In the perspective of Milisavljevic,Syed, Li & Xia (2024), the theory like reconfigurable manufacturing includes the technological development of the organisation which is a most important aspect of the operational management. In the context of reducing the challenges and helping the organisation the theory is important. Operational management plays an important role to manage the whole function of the organisation. Managing the production related issues and the issues related to the technological development operational management need to follow the above-mentioned theories. Fleet management faces different challenges in terms of managing the operations and the theory provides the way to overcome the challenges and also to overcome the other issues.

2.2.2 The Relationship Between Operational Challenges and Cost Effectiveness Efficiency

The relationship between operational challenges and the cost effectiveness efficiency of fleet management is a critical area of study in both theoretical and empirical research. Theoretical frameworks such as the resource-based view and transaction cost economics provide insights into how operational challenges impact

the allocation and utilization of resources within fleet management, influencing cost-effectiveness efficiency (Inc, 2023). Empirical studies have explored this relationship by examining factors such as maintenance issues, route optimization, fuel consumption, and driver behaviour, and their effects on fleet performance metrics such as vehicle utilization rates, fuel efficiency, maintenance costs, and overall operational expenses. Therefore, the relationship for hypothesis 1 as follow:

H0: Higher levels of operational challenges are not associated with decreased cost effectiveness efficiency.

H1: Higher levels of operational challenges are associated with decreased cost effectiveness efficiency.

2.3 Definition of Utilization of Technology

Utilization of technology in the context of vehicle fleet management refers to the strategic integration and application of technological tools and systems to enhance the efficiency, safety, and effectiveness of fleet operations. This encompasses a wide range of technologies, including but not limited to, GPS tracking systems, telematics devices, fleet management software, predictive analytics, and automated maintenance systems (Singh, 2023). The primary objective of leveraging technology in fleet management is to streamline processes, optimize resource utilization, improve decision-making, and ultimately achieve operational excellence in the management of vehicle fleets.

Route optimization

Sometimes issues related to the maintenance requirements are faced by fleet managers as in recent days, the location of fleet vehicles can be tracked by the software. As per

Sarraf & McGuire (2020), this kind of software aids in finding the best route for the vehicle. This aspect significantly helps in saving the overall timing also. Though the GPS data is valuable to the fleet managers in the field of keeping the track of vehicles, the complex needs of maintaining this often creates difficulties to the fleet managers.

Shortages of driver

The managers, recently, have become more concerned due to the lack of adequate drivers. According to Brand-Correa et al (2020), in current days, an escalation of the demand of freight transports can be seen; as a result, a need for the adequate number of drivers has also been noticed. In this case, the recruitment of efficient and skilled drivers is extremely necessary; however, the lack of experienced drivers creates a big challenge to the managers in the field of managing business operations in an effective way. Safety related issues can be caused due to the inexperienced drivers. Shortage of drivers is an issue that increases in the operation of fleet management and this problem needs to be managed by the fleet management.

Environmental controls

It is important for fleet management to take control of the environmental factors for maintaining the environmental laws. The environmental condition suggests the environmental control that includes the eco-friendly practices and awareness program between the employees. This program includes additional costs that affected the budget strategy of the fleet managers. As per Rehman et al (2021), operational management faced problems related to the environmental control's programs. Provide training to the employees and the drivers according to the rule of eco-friendly

practices. Operational management finds the process difficult and the effects of this program in the budget system create problems for the managers.

Digitalization and Automation of Transport

Digitalization and Automation of Transport presents a significant challenge for operational managers. The increasing demand for digital technologies in vehicles introduces advanced features that come with additional costs, potentially disrupting budget management. According to Sanguesa et al. (2021) and Keuchel, 2020), these automation processes can enhance vehicle longevity and reduce fuel costs. However, operational management faces difficulties in implementing these technologies and managing the systems involved in the technological development of vehicles. The advancement of these technologies includes features such as location tracking and route mapping for drivers.

2.3.1 Theory Associated with Utilization of Technology

The utilization of technology in vehicle fleet management is underpinned by various theoretical frameworks and concepts from fields such as information systems, operations management, and innovation theory. Information systems theory provides insights into the design, development, and implementation of technology-enabled solutions for fleet management. Concepts such as the technology acceptance model (TAM) help understand the factors influencing the adoption and usage of technology by fleet managers and drivers (Nastjuk, 2020).

Operations management theory contributes to the understanding of how technology can be leveraged to optimize fleet operations. For example, principles of lean management emphasize the importance of eliminating waste and improving

efficiency through continuous process improvement, which can be facilitated by technology-enabled solutions such as route optimization algorithms and real-time monitoring systems (Agrifoglio et. al, 2017).

Innovation theory offers perspectives on the role of technology as a driver of change and competitive advantage in fleet management. The diffusion of innovations theory, for instance, explains the process through which new technologies are adopted and diffused within organizations, highlighting the importance of factors such as compatibility, complexity, and observability. Furthermore, theories of human-computer interaction (HCI) and usability engineering provide guidance on designing user-friendly interfaces and systems that enhance the effectiveness and acceptance of technology among fleet managers and drivers (Tepe, 2020).

Overall, the utilization of technology in vehicle fleet management encompasses the strategic deployment of various technological tools and systems to improve operational efficiency and effectiveness. Theoretical perspectives from information systems, operations management, innovation theory, and HCI inform the analysis, design, and implementation of technology-enabled solutions, facilitating the achievement of organizational objectives in fleet management.

2.3.2 The Relationship Between Utilization of Technology and Cost Effectiveness Efficiency

Understanding the relationship between the utilization of technology and cost effectiveness efficiency of fleet management is crucial for optimizing fleet operations. Theoretical frameworks such as the technology acceptance model and the resource-based view offer insights into how the adoption and effective use of technology can

enhance operational efficiency and reduce costs in fleet management. Empirical research has examined this relationship by investigating the impact of technologies such as GPS tracking systems, telematics devices, and fleet management software on key performance indicators such as vehicle utilization rates, fuel efficiency, maintenance costs, and overall operational expenses (Inc, 2023). Therefore, the relationship for hypothesis 2 as follow:

H0: Higher levels of utilization of technology are not associated with increased cost effectiveness efficiency.

H1: Higher levels of utilization of technology are associated with increased cost effectiveness efficiency.

2.4 Definition of Driving Training and Performance Evaluation

Driving training and performance evaluation in the context of vehicle fleet management encompass the systematic processes designed to enhance the skills, knowledge, and safety practices of fleet drivers, as well as the assessment of their performance on the road (Murray et al, 2003). This includes various training programs, such as defensive driving courses, vehicle handling instruction, and safety training sessions, aimed at equipping drivers with the necessary competencies to operate vehicles safely and efficiently. Performance evaluation involves the ongoing assessment of drivers' adherence to safety protocols, compliance with regulations, and proficiency in driving techniques, with the goal of identifying areas for improvement and ensuring overall fleet safety and effectiveness.

2.4.1 Theory Associated with Driving Training and Evaluation Performance

The theory associated with driving training and performance evaluation draws from principles of adult learning theory, behavioural psychology, and performance management. Adult learning theory emphasizes the importance of learner engagement, relevance, and experiential learning in driving training programs. Concepts such as active participation, feedback, and real-world application are central to effective training interventions aimed at improving driver skills and behaviours (Bailey, 2022).

Behavioural psychology provides insights into the factors influencing driver behaviour and performance. Theories such as operant conditioning highlight the role of reinforcement and consequences in shaping driving habits, suggesting that performance feedback and incentives can be effective tools for promoting safe driving practices among fleet drivers.

Performance management theory offers frameworks for setting performance goals, measuring progress, and providing feedback to drivers (DeNisi and Pritchard, 2006). Concepts like the balanced scorecard approach enable fleet managers to evaluate driver performance across multiple dimensions, including safety, efficiency, and customer satisfaction, and to align training efforts with strategic objectives. Moreover, theories of risk perception and decision-making shed light on the cognitive processes underlying driver behaviour and safety performance. Understanding how drivers perceive and assess risks can inform the design of training programs and performance evaluation criteria aimed at reducing accident rates and improving overall fleet safety.

In summary, driving training and performance evaluation in vehicle fleet management are informed by theoretical perspectives from adult learning theory,

behavioural psychology, performance management, and risk perception. By leveraging these theories, fleet managers can design effective training interventions, implement performance evaluation systems, and promote a culture of safety and continuous improvement within their organizations.

2.4.2 The Relationship between Driving Training and Evaluation Performance, and Cost Effectiveness Efficiency

The relationship between driving training and performance evaluation with the cost effectiveness efficiency of fleet management is crucial for enhancing overall fleet performance. Theoretical frameworks such as adult learning theory and performance management offer insights into how comprehensive training programs and performance evaluations can contribute to improving driver skills, behaviours, and safety practices, consequently enhancing efficiency and reducing costs in fleet operations (Golfleet, 2023). Empirical research has investigated this relationship by examining the impact of driver training interventions and performance evaluations on key performance indicators such as accident rates, fuel consumption, vehicle maintenance costs, and overall operational expenses. Therefore, the relationship for hypothesis 3 as follow:

H0: Higher levels of driving training and performance evaluation are not associated with increased cost effectiveness efficiency.

H1: Higher levels of driving training and performance evaluation are associated with increased cost effectiveness efficiency.

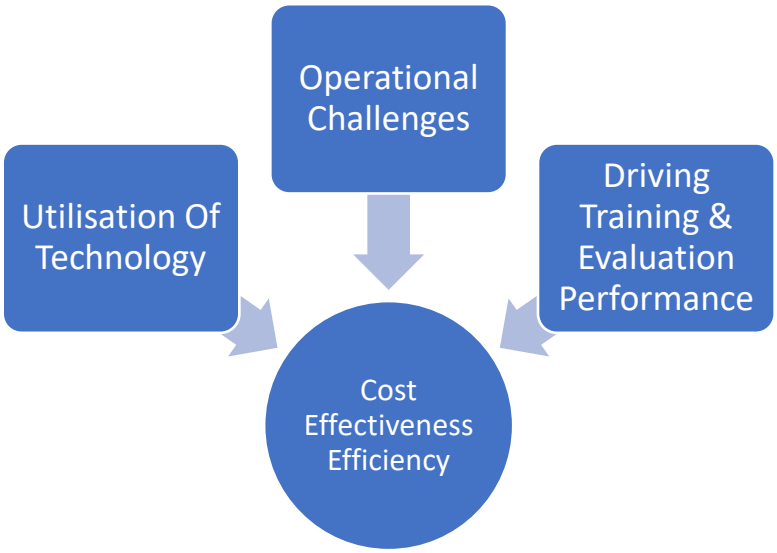

Figure 2.1 *The Relationship between utilisation of technology, operational challenges, driving training and performance evaluation and cost effectiveness efficiency*

From figure 2.1 it shows that, cost effectiveness efficiency is influenced by operational challenges, technology use, and driver training. Operational challenges range from maintenance to following rules, impacting efficiency and costs. Using technology like GPS and fleet software helps streamline processes and decision-making, improving efficiency. Investing in driver training improves skills and safety, reducing risks and boosting performance. By addressing these factors, organizations can develop strategies for success in a competitive environment.

2.5 Underpinning Theory

In the dynamic landscape of fleet management, achieving efficiency and cost-effectiveness is paramount for organizations striving to maintain a competitive edge. To understand and optimize performance in this domain, we explore three foundational theories which is the Resource-Based View (RBV), Technology Acceptance Model (TAM), and Performance Management Theory. These theories provide valuable insights into the internal dynamics of fleet management, shedding

light on how internal resources, technology adoption, and performance evaluation collectively shape operational success. By examining the underpinning principles of these theories, we can elucidate the key factors driving efficiency and cost-effectiveness in fleet management operations.

The Resource-Based View (RBV) framework provides a lens through which fleet management can understand its internal strengths and weaknesses in relation to competitive advantage (Kennedy, 2020). Within this framework, operational challenges, such as maintenance issues or workforce limitations, are perceived as internal constraints that can hinder fleet cost effectiveness efficiency. By recognizing these challenges as potential barriers to leveraging internal resources effectively, fleet managers can strategize to mitigate them, thereby optimizing their competitive position and performance in the market. The RBV thus underscores the importance of addressing operational challenges proactively to capitalize on internal resources and enhance fleet management effectiveness.

The Technology Acceptance Model (TAM) posits that the perceived usefulness and ease of use of technology influence its adoption. In the context of fleet management, the utilization of technology, such as GPS tracking systems and fleet management software, is guided by TAM. By ensuring that technological tools are perceived as valuable for improving efficiency and user-friendly for easy integration into daily operations, fleet managers can enhance their adoption and ultimately improve cost effectiveness efficiency in fleet management operations. TAM thus serves as a valuable framework for understanding and promoting the effective utilization of technology in fleet management (Koul, 2018).

Performance Management Theory emphasizes the importance of setting clear performance goals, tracking progress towards those goals, and providing

feedback to enhance organizational performance. In fleet management, performance evaluation plays a crucial role in assessing driver performance, identifying areas for improvement, and ensuring compliance with safety protocols. By systematically evaluating driver behaviour and performance, fleet managers can address inefficiencies, mitigate risks, and ultimately enhance fleet cost effectiveness efficiency. This theory provides a structured approach to continuously improving operational performance in fleet management, driving towards greater efficiency and effectiveness (Linn, 2023).

Integrating theoretical perspectives like the technology acceptance model and performance management theory, the conceptual framework offers a structured understanding of how operational challenges, technology utilization, and driver training collectively impact cost effectiveness efficiency in fleet management (Adjin, 2014). It recognizes the interdependence of these factors, highlighting the need for comprehensive solutions that address both technological and human elements. By leveraging this framework, fleet managers can strategize effectively, allocating resources to mitigate operational challenges, optimize technology utilization, and enhance driver training, thereby fostering improved efficiency and cost-effectiveness in fleet management operations.

2.6 Literature Gap

In the previous literature, not much information is found about the improvement of fleet management and vehicle utilisation in RMAF. It cannot provide the overall scenario of fleet management. Fleet management is a broad aspect and it needs more time to explore each part of the fleet management. The previous literature does not provide the detailed data about the topic and each aspect of fleet management. The

concept of fleet management needs to be more clearly described. These are literature gaps and it helps to understand the area that needs to be focused and also helpful for setting the objectives of the present study. In terms of understanding the focus of the research and also getting the goal for the research this part is extremely helpful.

2.7 Chapter Summary

In this chapter, the multifaceted dynamics of cost effectiveness efficiency in fleet management, considering operational challenges, utilization of technology, and driving training and performance evaluation as key factors influencing these outcomes were explored. Operational challenges encompass a broad spectrum of issues, from vehicle maintenance to regulatory compliance, all of which can significantly impact the efficiency and cost-effectiveness of fleet operations. Moreover, how the strategic utilization of technology, such as GPS tracking systems and fleet management software, can streamline processes, optimize resource allocation, and enhance decision-making were explored to improve overall cost effectiveness efficiency.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter focuses on the use of methods to execute this research. Various elements such as research philosophy, research approach and data collection method are discussed. Selections for all the elements of research methodology are justified.

3.1 Research Design

Qualitative and quantitative are the two common research approaches that researchers used to execute their research. In a quantitative approach, researchers focus on gathering numerical data (Taherdoost, 2022). Hence, it becomes possible for researchers to measure the outcome of their research. Qualitative approach, on the other hand urges researchers to focus on obtaining data related to views and experiences of human beings. In this research, a qualitative approach is followed to receive a deep understanding on the existing fleet management and vehicle utilisation practices followed at the RMAF and ways to make further improvements into the same.

The research design for this study emphasizes a quantitative methods approach to comprehensively investigate the challenges encountered by the RMAF in managing its land transport resources. Central to this approach is the utilization of structured questionnaires designed to systematically collect numerical data from various stakeholders involved in fleet management within the RMAF.

The questionnaire design process is meticulous, aiming to capture a wide range of quantitative metrics relevant to the study objectives. This include variables such as

vehicle utilization rates, maintenance schedules, fuel consumption patterns, budget allocations, and technology adoption levels. Each questionnaire item will be carefully crafted to ensure clarity and precision, enabling respondents to provide accurate and meaningful data.

The questionnaires have been distributed to a diverse sample of 33 stakeholders within the RMAF, including fleet managers, maintenance personnel, logistics experts, and frontline operators. The distribution strategy aimed to reach a broad cross-section of individuals involved in different aspects of fleet management, ensuring comprehensive coverage of perspectives and experiences.

Data collected through the questionnaires is subjected to systematic analysis using appropriate statistical techniques. Descriptive statistics has been used to summarize the key findings, providing insights into the current state of fleet management practices within the RMAF. Additionally, Additionally, reliability and validity analyses have been conducted on data collected to explore the relationships between variables and identify potential predictors of fleet performance.

3.2 Population, Sample and Unit of Analysis

The population under study encompasses all land transport resources within the RMAF, comprising various types of vehicles and personnel responsible for fleet management and operational activities. Within this diverse population, an Air Force College, Alor Setar has been selected as the sample area for the study. This sample will include a personnels involved in fleet management and operations, ensuring a comprehensive understanding of the challenges and dynamics associated with managing land transport resources within RMAF.

The unit of analysis for the study on fleet management within the Air Force College, Alor Setar primarily focuses on individual vehicles, as well as personnel and operational procedures related to fleet management. By concentrating on individual vehicles as the primary unit of analysis, the study aims to delve into factors such as utilization rates, maintenance schedules, and operational efficiency within the RMAF (Chiparo, 2022). This approach allows for a detailed examination of how individual vehicles are utilized, maintained, and managed within the context of fleet operations, providing insights into optimizing operational procedures and enhancing overall efficiency in managing the RMAF's land transport resources. Additionally, personnel involved in fleet management has been analysed to understand their roles, responsibilities, and challenges in managing land transport resources effectively. Operational procedures, including logistical processes and decision-making frameworks, were also examined to identify areas for improvement and optimization within RMAF's fleet management practices.

3.3 Sampling Design

Sampling is the method of selecting a small number of people from a large population to understand the perspective of the population on a particular subject. Probability and non-probability are the two common types of sampling technique used by researchers. In probability sampling, researchers consider everyone as a potential sample. Random sampling is one type of probability sampling. Researchers in non-probability sampling need to use their subjective judgement to select participants (Lehdonvirta et al, 2021). As part of non-probability sampling, convenience sampling will be followed to select the participants.

In employing a probability sampling approach, specifically systematic sampling, within the context of the Air Force College's land transport resources, respondents will be meticulously selected using a structured method of participant selection. This method ensures that each member of the population has a known, non-zero chance of being included in the study, thereby enhancing the representativeness of the sample.

Despite the unique challenges posed by the military environment, such as restricted access and operational demands, the utilization of a probability sampling approach offers several notable advantages. Firstly, it facilitates the attainment of a more accurate representation of the population, thereby enabling greater confidence in the generalizability of findings to the broader context of the Air Force College's land transport resources.

By meticulously selecting the respondents that directly involved in handling and managing of land transport resources at Air Force College, Alor Setar, the aim of the study is to achieve comprehensive coverage of diverse perspectives and experiences. This sample size has been carefully chosen to strike a balance between ensuring thorough data collection and analysis while remaining manageable within the constraints of the study's resources and timeframe. This is crucial for ensuring that any insights or interventions derived from the study are applicable and effective across diverse operational scenarios (Robbins, 2020).

Moreover, by employing a probability sampling approach, researchers can establish clear criteria for participant selection, thereby minimizing potential biases and enhancing the reliability and validity of the study findings. Through systematic random sampling or stratified sampling techniques, researchers can ensure that participants are chosen in a manner that is both objective and representative of the

population's diversity in terms of roles, experiences, and perspectives within the land transport resources (Ncsc, 2022). Given the dynamic and often unpredictable nature of military operations, convenient sampling allows researchers to efficiently recruit participants who possess valuable insights and experiences related to fleet management within RMAF.

Through systematic sampling, participants were selected based on their accessibility and relevance to the study objectives, ensuring a diverse representation of perspectives and experiences within RMAF's land transport resources. A total of 33 respondents were chosen out of a fleet management personal strength of 35 at the Air Force College, Alor Setar. The remaining 2 respondents were unavailable due to some operational requirements.

3.4 Questionnaire Preparation and Scale Type Used

To gather relevant data from participants within the RMAF regarding fleet management and vehicle utilization, a structured questionnaire will be developed. This questionnaire was meticulously crafted to ensure comprehensive coverage of various aspects related to fleet management practices and challenges.

The questionnaire was comprised a of closed-ended, which provide respondents with predefined response options, allowing for quantifiable data collection and analysis (Lorraine, 2023). These questions was cover a range of topics, including vehicle maintenance procedures, utilization rates, logistical challenges, and personnel training requirements. To measure respondents' agreement or disagreement with statements related to fleet management practices and challenges, a Likert scale type will be employed (Scales, 2006). The Likert scale allows respondents to indicate their level of agreement or disagreement with a series of statements by selecting from

a range of response options, typically ranging from to "Strongly Disagree" to "Strongly Agree". By using the Likert scale, the study can quantitatively assess participants' perceptions and attitudes towards various aspects of fleet management, providing valuable insights into areas of strength and areas for improvement within RMAF.

Through the careful preparation of a structured questionnaire closed-ended questions, as well as the utilization of the Likert scale type, this study aims to comprehensively capture the perspectives and experiences of participants within RMAF's land transport resources, thereby informing the development of strategies to enhance fleet management efficiency and effectiveness.

3.5 Data Collection Methods

It has already been mentioned that there is used of a quantitative approach to carry out this research. Hence, numerical data has been gathered from chosen participants in this research. Data are also distinguished as primary and secondary based on their sources. Primary data are those data gathered directly by researchers through field research. It is regarded that primary data are reliable and trustworthy (Jones & Donmoyer, 2021). On the other hand, secondary data are gathered by researchers mostly through library research. Researchers access online libraries to receive access to secondary data. It is easy and time-saving to collect secondary data. Nonetheless, primary data was gathered in this research as these types of data helping to offer an in-depth idea on the ways to improve fleet management and vehicle utilisation practices in RMAF.

Surveys constituted a primary method of data collection, allowing for the systematic gathering of quantitative data from personnel involved in fleet management

within RMAF. The surveys were distributed among a representative sample of personnel, utilizing the questionnaire developed in accordance with the structured questionnaire approach outlined in Section 3.4. By leveraging surveys as the primary data collection tool, this study aims to achieve a comprehensive understanding of fleet management practices and challenges within RMAF. The structured questionnaire approach ensures consistency and reliability in data collection, thereby supporting rigorous analysis and interpretation of findings (Analysis, 2024).

3.6 Reliability Test

All the gathered quantitative data has been analysed using partial least squares structural equation modelling (PLS-SEM) technique to test the research hypotheses. The use of the software also helps in measuring the reliability of the gathered data in this research. Cronbach's Alpha test will be made for that purpose. Cronbach's alpha is a widely used measure of internal consistency reliability, particularly in survey research, where it assesses the extent to which a set of questionnaire items consistently measures the same construct (Taber, 2017).

The reliability test using Cronbach's alpha coefficient has been evaluated the internal consistency of the questionnaire items related to fleet management and vehicle utilization. The results of the reliability test has been interpreted in accordance with established guidelines, with Cronbach's alpha values above 0.70 generally considered acceptable for research purposes (Delphine De Smedt et al., 2013).

3.7 Statistical Methods

Data analysis for this study encompass a range of statistical methods, including descriptive analysis, correlation analysis, and regression analysis, to provide a

comprehensive understanding of fleet management within the RMAF and identify opportunities for improvement.

Descriptive statistics was employed to summarize the characteristics of the sample and key variables related to fleet management. Descriptive analysis allows researchers to organize and present data in a meaningful way, providing insights into the distribution, central tendency, and variability of variables such as vehicle utilization rates, maintenance schedules, and operational efficiency (Taber, 2017). By summarizing key metrics and trends, descriptive analysis sets the foundation for further exploration and analysis of fleet management practices within RMAF.

3.8 Ethical consideration

This research was conducted following all the research ethics. First of all, informed consent was obtained from the participants. All the chosen participants was informed on the purpose of this research and the types of data that will be gathered from them. It is the ethical duty of researchers to collect informed consent from the participants (Xu et al. 2020). On the other hand, participants' personal information such as contact details and position in RMAF will be kept confidential. Participants were given freedom to withdraw from themselves from the research anytime and at any stage.

3.9 Chapter Summary

This chapter concluded that a quantitative approach was used to execute this research. As part of the quantitative approach, primary data will be gathered from the chosen participants. Systematic sampling, a probability sampling method, was used to select the participants. An estimated 33 people associated with the RMAF were chosen as participants in this research. A survey questionnaire was applied to obtain quantitative

data from the participants. SmartPLS software were used to interpret all the gathered quantitative data. Descriptive statistics, validity, and hypothesis tests were executed to assess all the numerical data obtained using the survey questionnaire. Approved informed consent forms were received from all participants before their participation in the research.

CHAPTER 4

DATA ANALYSIS

4.0 Introduction

The chapter is a crucial segment of the thesis as the researcher can analyse the collected data through various software in the chapter. Questionnaires and SmartPLS software were used to collect and analyse all gathered primary data from participants who are engaged with the survey. Descriptive, reliability and validity have been done by the researcher in the chapter to interpret all data and information effectively. Dependent and independent variables of the study are associated with each other and the relationship among these variables are mentioned here. Mean, median, mode, and Std. deviation value of these variables are discussed in the chapter in a systematic way. It helps the researcher to improve the quality of the study and analyse all collected data properly. The future researcher will be benefited through the thesis and these individuals can know about the improvement of vehicle utilisation and fleet management in RMAF.

4.1 Descriptive Statistics

Descriptive statistics involves summarizing and presenting the essential features of a dataset through measures of central tendency (mean, median, mode), dispersion (range, variance, standard deviation), and shape (skewness, kurtosis). It provides a clear overview of the data by detailing its central values, variability, and distribution patterns. Tools like frequency distributions, histograms, and summary tables help in understanding and interpreting the data, offering insights into its basic characteristics before conducting more advanced statistical analyses. (Editage, 2023).

Table 4.1 *Descriptive Statistics*

	N Stat	Min Stat	Max Stat	Mean Stat	Std. Dev Stat	Skewness Stat	Std. Error	Kurtosis Statistic	Std. Error
OC	33	33.4	40.5	37.5818	2.10482	-0.207	0.409	-1.223	0.798
UT	33	19.43	29.71	25.4978	2.87253	-0.232	0.409	-0.359	0.798
DEP	33	16.33	25.83	21.702	2.57011	-0.145	0.409	-0.122	0.798
CEE	33	26.33	38.44	31.7643	2.6155	0.28	0.409	0.32	0.798
Valid N (listwise)	33								

The descriptive statistics table presents key metrics for four variables: Operational Challenges (OC), Utilisation of Technology (UT), Driving Training & Evaluation Performance (DEP), and Cost Effectiveness & Efficiency (CEE), each based on a sample size of 33 observations. OC shows a mean of 37.5818 and a slightly negative skew (-0.207), indicating a distribution that leans leftward with a standard deviation of 2.10482. UT averages 25.4978 with a similar slightly negative skew (-0.232) and a standard deviation of 2.87253, suggesting a generally symmetrical distribution. DEP has a mean of 21.702, minimal skew (-0.145), and a standard deviation of 2.57011, indicative of a near-normal distribution. CEE, with a mean of 31.7643, shows a slight positive skew (0.280) and a standard deviation of 2.6155, suggesting a distribution slightly shifted to the right. Kurtosis values for all variables (-1.223 to 0.320) indicate platykurtic to mesokurtic distributions, suggesting variability in tail thickness. These statistics provide a clear understanding of the central tendency, variability, and shape of each variable's distribution, essential for interpreting their respective measures and informing further analytical insights. From the above table, it has been concluded that the study is effective and reliable with IVs and DV.

4.2 Evaluation of PLS-SEM Results

This study deployed the partial least squares structural equation modeling (PLS-SEM) technique to test the research hypotheses. SmartPLS software version 2.0.M3 developed by Ringle, Wende, and Will (2005) was used. The testing stage employed Smart PLS analysis to assess the reliability, validity, and hypothesis testing of the collected data. This sophisticated statistical technique offers a robust approach to structural equation modelling, particularly suitable for complex models with latent variables. Below is model of research framework that was running using the Smart PLS:

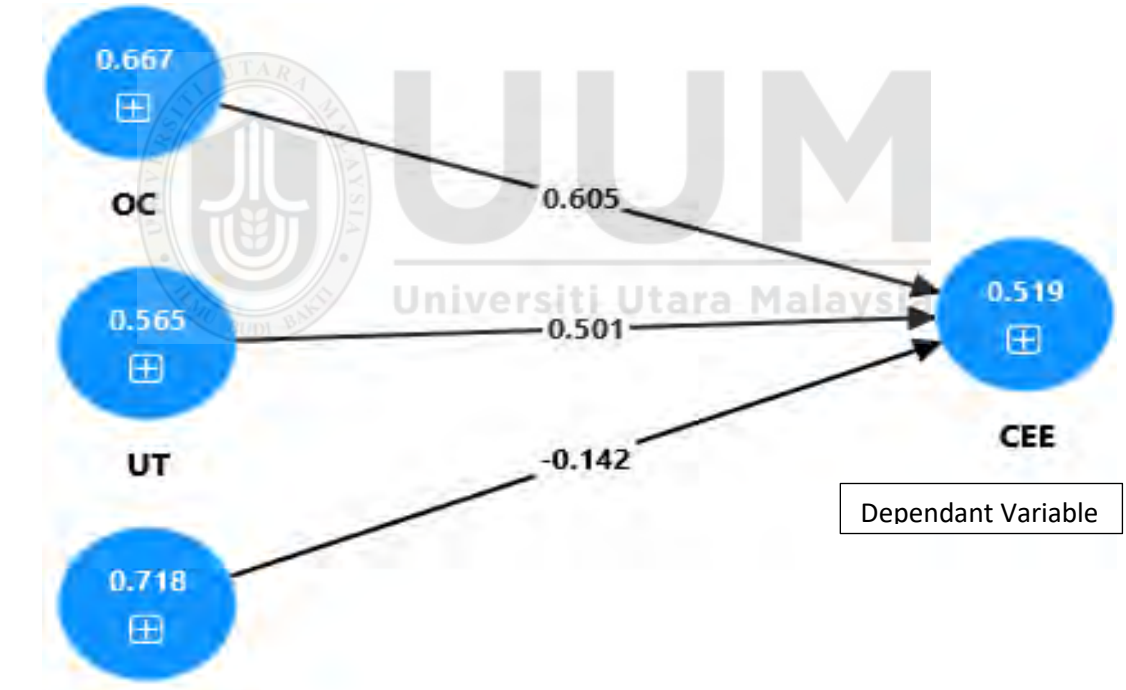

Figure 4.1 *Research Framework*

Table 4.2 *Reliability Test*

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CEE	0.759	0.820	0.837	0.519
DEP	0.832	0.945	0.876	0.555
OC	0.521	0.601	0.798	0.667
UT	0.807	0.841	0.864	0.564

From the table above, the reliability analysis shows that CEE, DEP, and UT have strong internal consistency and composite reliability, with Cronbach's alpha, composite reliability, and AVE all meeting or exceeding acceptable thresholds, indicating these constructs are reliably measuring their intended concepts. However, OC presents a mixed picture with acceptable composite reliability and AVE but a low Cronbach's alpha, suggesting potential issues with internal consistency despite the construct's ability to explain a significant amount of variance. Further review of OC's measurement items might be necessary to address its internal consistency concerns.

Table 4.3 *Validity Test*

	CEE	DEP	OC	UT
CEE				
DEP	0.845			
OC	0.567	0.592		
UT	0.914	0.877	0.560	

Based on the result from the table 4.3, the constructs (CEE, DEP, OC, UT) in the model demonstrate good discriminant validity, indicating they measure distinct concepts. The strong correlations within each construct also support good convergent validity, suggesting that the items within each scale are coherent and measure the intended constructs effectively.

Table 4.4 *Hypothesis Result*

	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**	**Decision**
CEE -> DEP	0.288	0.369	0.181	1.587	0.113	Not Supported
CEE -> OC	0.670	0.683	0.083	8.058	0.000	Supported
CEE -> UT	0.440	0.497	0.154	2.856	0.004	Supported

Based on result from table 4.2.5.3, it indicates that the construct CEE significantly influences OC and UT, as evidenced by statistically significant T statistics ($T > 1.96$) and low p-values ($p < 0.05$). However, there is no significant relationship between CEE and DEP based on the given data. These findings underscore the differentiated impact of CEE on various constructs within the model, highlighting areas of influence and indicating potential directions for further investigation or model refinement.

4.3 Demography and Others Analysis

Demography and other analyses as part of additional fleet management analysis is important because it offers a more comprehensive understanding of the operational environment. These analyses help identify trends and patterns that may not be immediately apparent through operational data alone. The details as follow:

Table 4.5 *Race of engaged participants*

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Malay	32	97.0	97.0	97.0
	Chinese	1	3.0	3.0	100.0
	Total	33	100.0	100.0	

A total of 33 numbers of participants are engaged in the survey and these individuals are from different cultures and backgrounds in the study. Engaged participants in the survey are mostly Malay and these individuals are associated with the RMAF. These people can know about the improvement of vehicle utilisation and fleet management of RMAF. Characteristics and behaviours of these individuals depend upon their respective races. More than 96% of individuals belong to Malay and only 3% of people are Chinese in RMAF. Malay individuals can know about the development of fleet management of vehicles. Therefore, RMAF should include people of different races to gain different working ideas and thoughts. It helps to improve vehicle utilisation and fleet management in RMAF and the work process is smooth with various ideas of people.

Table 4.6 *Age group of engaged participants*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 20	0	0	0	0
	21- 30	17	51.5	51.5	51.5
	31-40	15	45.5	45.5	97.0
	41 above	1	3.0	3.0	100.0
	Total	33	100.0	100.0	

Age group of engaged participants in the survey is a major demographic factor. It helps to understand the experiences of engaged participants in RMAF. A total four age groups are divided in the survey such as under 20, 21-30, 31-40, 41, and above. Most individuals are between the age group of 21-30 in the survey as these individuals can work hard in RMAF to improve vehicle utilisation and fleet management. More than 51% of individuals belong to the younger age group of RMAF. The middle age group people can make proper decisions and solve issues effectively. About 46% of middle age group people are engaged with the survey process to optimise land transport

resources. Only 3% of individuals are experienced and belong to the 41 and above age group in the survey. These individuals have experience about the development strategy of vehicle utilisation and fleet management in RMAF.

Table 4.7 *Marital status of engaged participants*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	9	27.3	27.3	27.3
	Married	24	72.7	72.7	100.0
	Total	33	100.0	100.0	

Marital status is another demographic element of the study and the researcher can identify individuals through single and married through the survey. More than 72% of individuals are married and these people can understand the improvement process of RAMF. Approximately 28% of people are single who are associated with the survey process in the study. It helps to understand the development strategy of vehicle utilisation and fleet management.

Table 4.8 *Educational qualification of engaged participants*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Secondary School	28	84.8	84.8	84.8
	Diploma	5	15.2	15.2	100.0
	Total	33	100.0	100.0	100.0

Educational qualification of individuals helps to understand capacity and capability of employees in RMAF. These people can provide their best efforts in the workplace to improve fleet management. It helps to identify capability of people in RMAF and these individuals are selected as the efficient employees. More than 84% of people have secondary education and these individuals are associated with RMAF. Approximately 15% of individuals have diploma education to improve vehicle utilisation and fleet

management. Educated and experienced employees can boost profitability and productivity of RMAF successively.

Table 4.9 *Designation of engaged participants*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	OIC/SNCO	6	18.2	18.2	18.2
	NCO	5	15.2	15.2	33.3
	Driver	19	57.6	57.6	90.9
	Other	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

Several designation people are available in RMAF Fleet Management such as Officer in-Charge/Senior Non-Commissioning Officer (OIC/SNCO), Non-Commissioning Officer (NCO), Driver, and Others. These designation people can provide their efforts to improve fleet management in RMAF. More than 57% of engaged participants in the survey are drivers and these individuals should know about the vehicle utilisation in RMAF properly. Approximately 19% of people are OIC/SNCO, 15% of individuals are NCO, and 10% of people are from other designation in RMAF. These individuals are experienced and educated as they can provide their best performance during working hours.

Table 4.10 *Experiences of engaged participants in RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	10	30.3	30.3	30.3
	5.2 – 10 years	3	9.1	9.1	39.4
	10.1 – 15 years	8	24.2	24.2	63.6
	15.1 – 20 years	9	9.1	9.1	90.9
	Above 20 years	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

Experiences of the engaged participants vary from 1-5 years to more than 20 years of length of services in RMAF. These individuals can serve their best performance and

activity in RMAF to improve fleet management and land transport resources. More than 30% of people have 1-5 years of experience. About 10% of individuals have 5.1 to 10 years of experience and approximately 25% of people have 10.1-15 years of experience in RMAF. It helps to improve the activities and services of engaged participants in the survey. More than 27% of individuals have 15.1-20 years of experience and only 10% of people have more than 20 years of experience in RMAF. Experienced and motivated employees can improve fleet management & vehicle utilisation in RMAF.

Table 4.11 *RMAF's fleet management system is effective at optimizing vehicle utilization*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	12.1	12.1	12.1
	Agree	27	81.8	81.8	93.9
	Strongly agree	2	6.1	6.1	100.0
	Total	33	100.0	100.0	

RMAF's fleet management is the most effective in optimizing vehicle utilization and the analysis based on the responses from the respondents has given the clear picture of this statement. The analysis has explained that the maximum number of respondents, a percentage of 81.82%, have given the most positive responses and agreed that the statement is true. Simultaneously the 6.06% of the respondents have strongly agreed with the statement. It is also true that a number of respondents, a percentage of 12.12% has naturally reacted with this statement.

Table 4.12 *Managing RMAF's land transport resources is challenging in vehicle maintenance issues*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3	3	3.0
	Agree	23	69.7	69.7	72.7
	Strongly agree	9	27.3	27.3	100.0
	Total	33	100.0	100.0	

The land transport resources of RMAF are challenging in vehicle management issues and this statement has been stated for the responses. According to the responses most of the respondents have agreed with the motion and it has been noticed that 69.70% of respondents have agreed with the statement. It has also noticed that the percentage of 27.27% of respondents have strongly agreed with the motion and the respondents truly believes that the statement is authentic and the RMAF's land transport resources are challenging in vehicle management issues. In this data analysis it has been noticed that the 3.03% respondents have reacted naturally. The majority part of the respondents has agreed or strongly agreed the motion.

Table 4.13 *Managing RMAF's land transport resources is challenging in timely deployment for missions*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3.0	3.0	3.0
	Agree	27	81.8	81.8	84.8
	Strongly agree	5	15.2	15.2	100.0
	Total	33	100.0	100.0	

The statement RMAF's land transport resources are challenging in timely deployment for the mission has got the responses. The respondents of 81.82% have agreed with the statement and the percentage of 15.15% of respondents have strongly agreed with the statement and simultaneously the 3.03% of respondents have given neutral

responses about this statement. The percentage of the responses denotes that the statement that has been given to the respondents is true and authentic. The respondents believed that the land transport resources are challenging in timely deployment for the missions. The opinions of the respondents have given the idea about the present scenario about the RMAF's land transport resources.

Table 4.14 *Managing RMAF's land transport resources is challenging in driver shortage*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3.0	3.0	3.0
	Agree	18	54.5	54.5	57.6
	Strongly agree	14	42.4	42.4	100.0
	Total	33	100.0	100.0	

Driver shortage is one of the most important parts of the land transport resources and this statement has been placed for the responses. The responses from the respondents have given a clear picture of the scenario and the data analysis has explained that a percentage of 54.55% has agreed with the statement and a percentage of 42.42% of respondents have strongly agreed with the motion. There are a small number of respondents who are given the neutral responses. Analysing the responses, it has been considered that the driver shortage is one of the issues that are faced by the RMAF in terms of land transport resources.

Table 4.15 *Operational challenges will impact the deployment time for RMAF missions*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	12.1	12.1	12.1
	Agree	20	60.6	60.6	72.7
	Strongly agree	9	27.3	27.3	100.0
	Total	33	100.0	100.0	

Operational challenges impacting the deployment time for the RMAF mission have been placed for the responses and the responses from the respondents have been collected to analyse. The analysis of the responses from the respondents has explained that the 60.61% participants have agreed with the motion and simultaneously the 27.27% of participants have strongly agreed and the analysis of the responses has proved that the operational challenges are impacting on the deployment time for the missions.

Table 4.16 *RMAF's fleet management and vehicle utilization facing a new challenge and need improvements*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	23	69.7	69.7	69.7
	Strongly agree	10	30.3	30.3	100.0
	Total	33	100.0	100.0	

It is true that the fleet management and vehicle management has faced several challenges and it has to be improved. As per the analysis of the respondent's responses the 69.70% of participants have agreed with the statement. Besides this the 30.30% of respondents have given the strongly agreed responses to this motion. The analysis of the responses has made the scenario clear that the RMAF's fleet management is facing the challenges and it needs to be rectified. And this statement has only the agreed and strongly agreed responses. The responses have proved the trueness of this statement.

Table 4.17 *Data analytics can optimize vehicle utilization and reduce operational downtime within RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	9.1	9.1	9.1
	Agree	22	66.7	66.7	75.8
	Strongly agree	8	24.2	24.2	100.0
	Total	33	100.0	100.0	

The responses collected for the data analytics are helping to optimize the vehicle utilization and reduce the operational downtown within RMAF. The response has given the scenario that 66.67% of all the participants have agreed that the data analytics have the potential to make an optimization on the utilization of the vehicles. Simultaneously 24.24% of the participants strongly agreed about the potentiality of data analytics. As per the data analysis this has been noticed that the 9.09% of respondents remain neutral. The analysis of the responses has proved that the data analytics have the positive role in optimizing the vehicles utilization and reducing the operational downtown.

Table 4.18 *Predictive maintenance can optimize vehicle utilization and reduce operational downtime within RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	9.1	9.1	9.1
	Agree	27	81.8	81.8	90.9
	Strongly agree	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

Predictive management is the most important part of the optimization of the operation and this statement has been placed for collecting the responses from the participants. The data analysis has given the information that 81.82% of respondents have reacted as agreed with the motion. The 9.09% of participants have strongly agreed with the motion and 9.09% of participants have given neutral responses to the motion. The

responses from the participants helped to assess the requirement of predictive management in the business operation. Simultaneously predictive management can give a new dimension in the optimization of operation and can help to reduce the downtown of the RMAF's vehicle management.

Table 4.19 *Importance of integrating technology to improve fleet management and vehicle utilisation within RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	12.1	12.1	12.1
	Agree	16	48.5	48.5	60.6
	Strongly agree	13	39.4	39.4	100.0
	Total	33	100.0	100.0	

Fleet management and vehicle utilisation are crucial factors for RMAF to develop its transport resources. Integrating technology plays a significant role to ensure fleet management and optimisation in RMAF (Mehmood, 2021). The above graph represents the respondents about the necessity of modern technology to improve vehicle utilisation and fleet management within RMAF. most individuals agreed with the above statement by 48.48% in Malaysia. More than 398% of individuals strongly agreed with the above statement to improve vehicle optimisation in the country. About 12% of people are confused about making the right decisions about the statement. Fleet management helps a driver to maintain his or her safety during driving time on the road. Hence, RMAF should focus on advancement of technology and machines in RMAF to boost fleet management and vehicle utilisation successively.

Table 4.20 *Impact of modern technological infrastructure to address operational challenges in fleet management*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	9.1	9.1	9.1
	Agree	12	36.4	36.4	45.5
	Strongly agree	18	54.5	54.5	100.0
	Total	33	100.0	100.0	

Operational challenges create a negative impact on modern technological infrastructure and it can hamper fleet management in RMAF. Fleet management can ensure fuel efficiency, vehicle lifespan, and vehicle maintenance (Zhang et al. 2021). Lack of fleet management is a major challenge for RMAF to optimise vehicle performance. Most individuals strongly agreed with the necessity of modern technological infrastructure to identify operational challenges in fleet management. More than 54% of individuals strongly agreed with the statement and about 36% of people agreed with the above statement to improve fleet management and performance of vehicles in RMAF. Approximately 10% of individuals cannot agree and disagree with the above statement due to a lack of experience and information about fleet management. From the above discussion, it has been stated that operational issues of fleet management are identified with the positive impact of modern technological infrastructure in RMAF.

Table 4.21 *Impact of budget constraints to implement advanced technology solutions for fleet management in the RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	5	15.2	15.2	15.2
	Agree	14	42.4	42.4	57.6
	Strongly agree	14	42.4	42.4	100.0
	Total	33	100.0	100.0	

Budget constraints are major barriers for the modern technological solutions for fleet management in RMAF. Lack of financial support cannot maintain performance and growth of fleet management in vehicle optimisation (Naumov, Keith &Sterman, 2023). Advanced technology helps to identify challenges and its solutions for fleet management in RMAF. The above table representation indicates obstacles to implement advanced technology solutions for fleet management. More than 42% of survey participants agreed and strongly agreed with the above statement. These individuals are experienced about the impact of modern technological solutions in fleet management and vehicle optimisation in Malaysia. Technological advancement is required for optimising land and transport resources to enhance fleet management in RMAF. Budget constraints are a major issue for vehicle optimisation and fleet management in the country.

Table 4.22 *Lack of technical expertise creates a barrier against effective implementation of advanced technology solutions for fleet management in the RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	6.1	6.1	6.1
	Agree	18	54.5	54.5	60.6
	Strongly agree	13	39.4	39.4	100.0
	Total	33	100.0	100.0	

Technical expertise is needed to use modern and advanced technology in the workplace. These individuals are talented and experienced in the usage of modern technology in RMAF. Technical support is essential for the modern technology solutions for fleet management. The above table represents barriers against effective implementation of advanced technology solutions for fleet management. Most individuals strongly agreed with the above statement. About 40% of people strongly agreed with the statement and more than 54% of individuals agreed with the statement.

Hence, it has been concluded that lack of technical support creates a major obstacle for technological advancement in fleet management and vehicle performance. RMAF should focus on its technology and technical mechanics to boost transport resources and vehicle lifespan successfully. Technological advancement is required for RMAF to provide instant services as per the requirements.

Table 4.23 *Resistance to change from personnel create a barrier against effective implementation of advanced technology solutions for fleet management in the RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	5	15.2	15.2	15.2
	Agree	25	75.8	75.8	90.9
	Strongly agree	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

Resistance to change from personnel creates a significant barrier against implementation of modern technology and solutions for fleet management. The above table represents resistance to change from personnel effect on technological advancement for fleet management in the RMAF. Technological advancement helps to provide solutions against fleet management (Paiva et al. 2021). More than 54% of individuals agreed with the statement to provide effective solutions for fleet management. These individuals are associated with the RMAF and people have experiences about solutions of the management. More than 30% of people strongly agreed with the above statement and these individuals can find solutions against the barriers of fleet management in RMAF. It helps to improve vehicle sustainability, performance, efficiency, and lifespan respectively in Malaysia. From the above discussion, it has been stated that resistance to change from personnel is a crucial challenge to implement advanced technology solutions for fleet management.

Table 4.24 *Integration issues with existing systems create a barrier against effective implementation of advanced technology solutions for fleet management in the RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	1	3.0	3.0	3.0
	Neutral	4	12.1	12.1	15.2
	Agree	18	54.5	54.5	69.7
	Strongly agree	10	30.3	30.3	100.0
	Total	33	100.0	100.0	

Integration issues are major barriers against implementation of advanced technology solutions for fleet management. The above table represents the impact of issues on advanced technological solutions for the management. Most individuals agreed with the above statement and these individuals are associated with RMAF directly. These people can know about the integrated technologies and its impact on fleet management. More than 54% of people agreed with the above statement and about 31% of individuals strongly agreed with the statement. Approximately 12% of people cannot make decisions about integration issues with existing systems in fleet management. About 3% of individuals disagreed with the above statement as these individuals cannot experience the advancement of technology in fleet management. It has been concluded that integration issues with the existing systems are barriers against implementation of advanced technology solutions for fleet management in RMAF.

Table 4.25 *Current driver training programs offered within RMAF is satisfied*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	3	9.1	9.1	9.1
	Neutral	2	6.1	6.1	15.2
	Agree	17	51.5	51.5	66.7
	Strongly agree	11	33.3	33.3	100.0
	Total	33	100.0	100.0	

The driver training programs for the RMAF are satisfied and the responses have been collected from the end of the participants. It is necessary to collect the participants' responses and 51.52% of participants agreed with the statements. Simultaneously a percentage of 33.33% have strongly agreed with the motion and 9.09% have disagreed with the motion. The majority of the respondents have agreed and strongly agreed the motion and proved that training program of the drivers are satisfied.

Table 4.26 *Implementing advanced driver training programs could help mitigate operational challenges and enhance vehicle utilization*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3.0	3.0	3.0
	Agree	21	63.6	63.6	66.7
	Strongly agree	11	33.3	33.3	100.0
	Total	33	100.0	100.0	

Implementation of the advanced driving training program is needed for limiting the operational challenges and the responses that have been collected have explained that 63.64% of the participants have agreed with the statement. The percentage of 33.33% of participants have strongly agreed with the motion that has been stated. The majority of the respondents have agreed or strongly agreed that the implementation of the advanced technologies can mitigate the challenges and can enhance the vehicle utilization in the operation of the RMAF. Implementation of the new driver training program can help the drivers to be more efficient in transport and can enhance the

experience in transporting and utilizing the vehicles. The data analysis has proved that the respondents are agreed and strongly agreed that the implantation should be done in the company to mitigate the challenges in operation.

Table 4.27 *Effectiveness of current methods to evaluate RMAF drivers' proficiency in handling domestic vehicles and equipment*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	3	9.1	9.1	9.1
	Neutral	1	3.0	3.0	12.1
	Agree	18	54.5	54.5	66.7
	Strongly agree	11	33.3	33.3	100.0
	Total	33	100.0	100.0	

RMAF drivers' proficiency is essential to handle domestic vehicles and equipment with the help of current methods. Driver's efficiency and efficacy are improved through the effectiveness of current methods in RMAF. Domestic vehicle performance and efficiency are developed through RMAF drivers' proficiency. The above table indicates the effectiveness of current methods to evaluate RMAF drivers' proficiency in handling domestic vehicles and equipment. Individuals are strongly agreed, and agreed with the above statement and these people are experienced with the RMAF's efficiency and performance. About 55% of people agreed with the current methods to evaluate RMAF drivers' proficiency in handling domestic vehicles and equipment. More than 33% of individuals strongly agreed with the above statement. More than 9% of people disagreed with the statement as these individuals cannot focus on current methods in vehicle performance and optimisation in fleet management of the RMAF. From the above interpretation, it has been stated that current methods are essential to evaluate RMAF drivers' proficiency effectively.

Table 4.28 *Quality of driver training programs to maintain a strong correlation with overall fleet performance within the RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	3	9.1	9.1	9.1
	Neutral	1	3.0	3.0	12.1
	Agree	15	45.5	45.5	57.6
	Strongly agree	14	42.4	42.4	100.0
	Total	33	100.0	100.0	

Necessity of driver training programs and fleet performance are associated with each other and it helps to improve efficiency and efficacy of RMAF's drivers in the global market. The above table representation indicates the quality of driver training programs to maintain a strong correlation with overall fleet performance within the RMAF. Most individuals strongly agreed with the above statement and more than 42% of people strongly agreed with the statement. About 45% of individuals agreed with the above statement as these individuals are experienced about the relationship between fleet performance and quality of training programs in RMAF. From the above discussion, it has been stated that the necessity of driver training programs is related with the overall fleet performance within the RMAF.

Table 4.29 *Data on vehicle maintenance schedules and repair history*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	6	18.2	18.2	18.2
	Agree	23	69.7	69.7	87.9
	Strongly agree	4	12.1	12.1	100.0
	Total	33	100.0	100.0	

The respondents were first asked about their opinion on whether data regarding vehicle maintenance schedules and the service history of the vehicles are transparent and accessible or not. To this, ***69.70%*** of the respondents have expressed their ***strong agreement***. This has been followed by ***18.18%*** who have expressed their ***mere***

agreement. The remaining ones have expressed their ***neutral*** opinion. Information on the service schedules and service history are easily accessible by the stakeholders and can be obtained whenever needed.

Table 4.30 *Use of SOPs in efficient fleet management and vehicle utilization*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	9.1	9.1	9.1
	Agree	24	72.7	72.7	81.8
	Strongly agree	6	18.2	18.2	100.0
	Total	33	100.0	100.0	

The second question is all about the opinion of the stakeholders on the existence of Standard Operating Procedures (SOPs) in order to enhance efficient management of fleet effective vehicle utilization in the RMAF. To this, ***72.73%*** of the stakeholders have expressed their ***strong agreement***. The percentage of respondents expressing their ***mere agreement*** is represented by ***18.18%***. The remaining ***9.09%*** percentage has been ***neutral*** to the fact. The need for Standard Operating Procedures (SOPs) for efficient fleet management has been proved by the strong agreement of the stakeholders to the same.

Standard Operation Procedure (SOPs) is an integral part and their importance for the success of any organization cannot be ruled out. They are a strategic framework which enables an organization to complete a task or procedure. The application of SOP enables an organization to maintain consistency and accuracy in their day-to-day operation procedure (Bashatah et al. 2021). Proper compliance of the rules and guidelines are also ensured with the application of the same. With the application of SOPs valuable information is provided to the employees, so that they can finish their assigned tasks successfully.

Regarding a defense wing of Malaysia, operational efficiency and accuracy cannot be compromised and the existence of the same cannot be ruled out. The application of SOP in the day-to-day operation of the RMAF enables them to successfully execute their tasks and complete the same. With the application of the same, proper coordination among the associated personnels is ensured. The importance of the vehicle fleet management in the RMAF is important and the application of SOP in the same enables proper communication and coordination among the personnels present in this wing and also with the other wing.

Table 4.31 *Use of data analysis technique by RMAF to identify patterns and areas of improvement*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	2	6.1	6.1	6.1
	Agree	28	84.8	84.8	90.9
	Strongly agree	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

The stakeholders were further asked on whether the RMAF utilizes data analysis techniques to identify trends, patterns and areas of improvement in the fleet management process and effective utilization of their vehicles. To this, ***84.85%*** of the stakeholders have expressed their ***strong agreement***. This has been followed by ***9.09%*** of stakeholders who have expressed their ***mere agreement***. The remaining ***6.06%*** have expressed their ***neutral opinion***.

It has been found that RMAF inducts the ***3D Scanning technology*** for the effective maintenance of its aircrafts and other associated vehicles. This technology also helps in tracking the location of the same (Venugopal et al. 2021). This technology enables the department to monitor deterioration of various components of the machine, remove the wared-out parts and repair the defected ones. Fleet

management can similarly implement this technology to enhance the maintenance and operational efficiency of their vehicles.

Table 4.32 *Use of manual logs and records in vehicle deployment and usage*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	3.0	3.0	3.0
	Agree	24	72.7	72.7	75.8
	Strongly agree	8	24.2	24.2	100.0
	Total	33	100.0	100.0	

When any vehicle is deployed for the respective in the RMAF, proper tracking and constant monitoring of the same is necessary. Monitoring includes the real time monitoring of the vehicle so that complete information can be obtained by the department on the exact location of the vehicles (Li, Batty & Goodchild, 2020). For the same, induction of technologically advanced software is needed which will fulfill the purpose. The stakeholders were asked about the use of various software by RMAF to fulfill the same purpose. The first question was all about the use of ***manual log and records***. To this, ***72.73%*** of the respondents have expressed their strong agreement. This has been followed by ***24.24%***, who have expressed their ***mere agreement***. The remaining ***3.03%*** have been ***neutral***. This implies that RMAF uses manual records and log book.

Table 4.33 *Use of fleet management software for vehicle usage and deployment*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	3	9.1	9.1	9.1
	Neutral	6	18.2	18.2	27.3
	Agree	22	66.7	66.7	93.9
	Strongly agree	2	6.1	6.1	100.0
	Total	33	100.0	100.0	

The advancement of modern technology has led to the introduction of dedicated software which enables companies to track and monitor the real time location of their vehicles. The same is also used by the RMAF, the insight to which can be obtained based on the graphical interpretation of the opinion of the stakeholders. ***66.67%*** of the stakeholders have expressed their ***strong agreement***. This has been followed by ***18.18%*** who have expressed their ***mere agreement***. 9.09% of the respondents have been neutral to this. The rest ***6.06%*** have expressed their ***mere disagreement***. This depicts the fact that RMAF uses dedicated software which enables them to track the real time location of their vehicles. This can only be possible if the vehicles are installed with a ***Global Positioning System (GPS) tracking chip.*** The question on this has been asked below.

Table 4.34 *Use of GPS tracking system for vehicle usage and deployment*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	5	15.2	15.2	15.2
	Neutral	6	18.2	18.2	33.3
	Agree	21	63.6	63.6	97.0
	Strongly agree	1	3.0	3.0	100.0
	Total	33	100.0	100.0	

Regarding the use of GPS tracking systems by the RMAF in their vehicles, ***63.64%*** of the respondents have expressed their ***strong agreement***. This has been followed by ***18.18%*** of the respondents having expressed their ***mere agreement***. ***15.15%*** have been ***neutral*** to this fact. The remaining ***3.03%*** have expressed their ***mere disagreement***. From this analysis, this fact can be interpreted that RMAF used a GPS tracking system in their vehicles. They installed a tracking chip, which enables the surveillance department to keep a proper track of the location of their vehicles.

Table 4.35 *Regular assessments and audits to ensure compliance of rules*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	12.1	12.1	12.2
	Agree	24	72.7	72.7	84.8
	Strongly agree	5	15.2	15.2	100.0
	Total	33	100.0	100.0	

Proper assessment and audits must be conducted in order to ensure that proper risk management policies and regulations are abided by at the workplace. The same is followed by the RAMF at their premises as well, the insight to which can be obtained from the above graphical analysis. ***72.7%*** of the stakeholders have expressed their ***strong agreement.*** This has been followed by ***15.2%*** who have ***merely agreed*** to the same. The remaining ***12.1%*** have been ***neutral***.

Table 4.36 *Overall coordination and communication between different units of RMAF*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not agree	2	6.1	6.1	6.1
	Neutral	3	9.1	9.1	15.2
	Agree	25	75.8	75.8	90.9
	Strongly agree	3	9.1	9.1	100.0
	Total	33	100.0	100.0	

Proper communication is highly essential in order to ensure proper coordination among the various departments of the RMAF which are involved in the management of the fleet. The existence of the same was asked to the stakeholders of RMAF. To this, ***75.8%*** of them have expressed their ***strong agreement***. This has been followed by ***9.1%*** who have been both ***positive*** as well as ***neutral*** to the fact. This implies that, ***9.1%*** of the stakeholders have expressed their both ***mere agreement*** to the fact and also had been ***neutral*** to the same. The remaining ***6.1%*** have expressed their ***mere disagreement***.

Proper communication and coordination is necessary in an organization in which there are various departments associated with the operation process and which are all interconnected with each other. The existence of this ensures smooth operation of the organization in various ways such as ***effective decision making***, ***enhancement of efficiency in the operation process***, ***enhancement of productivity***, ***job satisfaction among the employees*** and ***overall motivation and morale among the employees is enhanced*** (Kharouf et al. 2020)**.** Talking about the RMAF, a department which is into the protection of the country, proper communication and coordination among the associated departments is highly essential. The department in the RMAF, which is associated with the maintenance of the vehicles, is the core wing of the department. Hence, proper communication and coordination among the members in that wing and also with the personnels of the other wing is highly essential (Janssen, 2023). The existence of the same has been proved by obtaining the opinion of the associated stakeholders.

4.4 Hypothesis Analysis

Hypothesis 1- Higher levels of operational challenges are associated with decreased efficiency and increased costs.

It is evident from the above findings that increased operational challenges are likely to bring about reduced efficiency and enhanced costs within fleet management operations. This hypothesis postulates to the effect that when operational challenges are and mount in fleet management, efficiency reduces and costs are incurred. There are several studies which corroborate this association. For example, Chiparo, Tukuta,

and Musanzikwa (2022) highlighted the study of the practices of vehicle fleet management in Zimbabwe state-owned enterprises. They discovered that resource constraints, including inadequate funding, wrong policies, and scarcities of spares, negatively impacted efficiency and increased the costs of maintenance and repairs. Similarly, Gitahi and Kinyanjui (2014) investigated the UN fleet management in operation in Kenya. They concluded that practical difficulties such as inadequate vehicles, poor roads as well as absence of adequate skills reduced receptiveness as well as increased cost. Moreover, industry research identifies possible yet recurrent issues that adversely affect fleet performance. Alexis (2023) identifies the following as challenges; This include delays in maintenance, non-adherence to regulatory provisions and regulations, and poor routing. Axestrack Solutions (2023) posits that driver scarcity, idle assets, and restricted data availability remain the same issues faced. The rate at which these issues intensify is coupled with a decline in productivity of the fleet and instances of excessive expenditure of funds (Summers, 2024). These insights are backed by complexity theory. When it comes to the description of a complex adaptive system which a fleet is, Turner and Baker (2019) state that it consists of numerous interdependent components. Disruptions at the operational level can amplify at the nodes and result in system failures. If the challenges are not managed, the efficiency is lowered and the cost rise. Motive (2024) says that pureplay limitations limit the data processing required to detect and address operational challenges. The implementation of Integrated Management System can offer needed visibility using advanced information technologies in fleet management (Singh, 2023). In addition, AI and automation can offset some of the challenges that are inherent to human resources (Sallam, Mohamed & Mohamed, 2023). Hence, the studies done on the public and private sector fleets are in line with the view that higher operational

impediments correlate with lower efficiency and increased cost of managing fleets. Among the factors that must be considered in the achievement of improved performance, it is important to note that overcoming the mentioned challenges will be facilitated by technological advancements.

Hypothesis 2 - Higher levels of utilization of technology are associated with increased cost efficiency effectiveness.

The study also found that the higher the ICT usage, the better it is in enhancing efficiency and reducing the cost of running fleets. This hypothesis assumes that the adoption of technology results into better fleet utilization and reduced cost. The literature supports this association from different perspectives. First, fleet management systems themselves as a technological application of optimization are considered. For instance, Linn and Linn (2023) describe how the use of GPS, measurements of drivers activities, and effective route planning enhances vehicle utilization, employee performance, and fuel efficiency. Also, a large number of research findings show that operating fleets are likely to accrue positive benefits from technology spending. Amouzegar, Tripp and Galway (2004) has provided an account of the US Air Force logistics wherein though predictive data modelling has been used to reduce aircraft downtime by 65 % and reduce supplies inventory. A cross-sectional study carried out by Ali (2018) on Kenyan transport firms revealed that there was a positive relationship between technology spending and increases in profitability and market share. Similarly, Chiparo, Tukuta and Musanzikwa (2022) also associated higher levels of advance fleet IT with better service delivery and improved customer satisfaction. Acceptance levels also matter. As Nastjuk et al (2020) have noted, these choices are

due partly to users' willingness to accept new vehicle technologies. Only when the manager and operator are committed, can tools such as telematics and analytics tools be utilised in the best possible manner. Culture and training provide the required degree of technological literacy (Koul & Eydgahi, 2018). Interpretation is aided by the fact that they are complex for the purpose of the present study, as has been explained under the category of complexity theory. In their report, Turner and Baker (2019) elaborate on how technologies increase available choices within complex systems such as fleets. More opportunities imply better chances for restructuring and adaptation to unfavourable conditions which harm effectiveness. Technology can enable managers to predict, prepare and act thus being a effective tool for preparing for the future.

In total, by applying the concept of the fleet technologies, the evidence has shown that users can easily manage the numerous relations and risks that define the operations. The net effect is increased productivity, utilization as well as cost efficiency of the organizational assets. This is in line with the study hypothesis which states that higher levels of utilization of technology are associated with increased efficiency and cost-effectiveness in fleet management operations.

Hypothesis 3 - Higher levels of driving training and performance evaluation are associated with increased cost efficiency effectiveness.

Based on the results of the tests conducted, Hypothesis 3 is not supported. Contrary to the hypothesis that driving training and performance evaluations are positively related to the cost efficiency effectiveness and of fleet management operations, the data does not substantiate this relationship. Despite previous findings, such as those by Gitahi

and Kinyanjui (2014) and the general consensus in the literature that driving skills enhancement can lead to improved fleet management outcomes, our analysis reveals no significant evidence supporting this correlation. Additionally, although coaching programs and behavioural change processes have been reported to reduce accidents and violations (Golfleet, 2023; Axestrack Solutions, 2023), and curriculum-based instruction has shown some improvement in driver behavior (Bailey, Wundersitz, et al., 2022), these factors do not demonstrate a consistent or substantial impact on overall operational efficiency and cost-effectiveness in the context of fleet management.

4.5 Chapter Summary

This chapter provides an analysis of the collected data, including detailed descriptive statistics that reveal the central tendencies and distribution characteristics of key variables. Integrating technology plays a significant role to ensure fleet management and optimisation in RMAF. Consistent and accurate prediction regarding the areas for conducting maintenance work can enhance maintenance efficiency while reducing operational cost for the organisation. The study helps to improve land transport resources, vehicle utilisation, and fleet management in RMAF. Maintenance of the resources is vital for management of land resources by the organisation. Fleet management and vehicle utilisation are crucial factors for RMAF to develop its transport resources.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

In this chapter, the research findings and their implications will be succinctly summarized, aligning them with the predefined research objectives and proposed hypotheses. The conclusion will encapsulate key takeaways drawn from the empirical analysis, highlighting their relevance to the original research objectives. The chapter ends with the limitations of the study and some suggestions for future studies.

5.1 Recapitulation and Summary of Findings

The research on fleet management and vehicle utilization at RMAF reveals several critical areas needing attention. The current fleet management system is effective in some aspects but faces significant challenges, particularly in vehicle maintenance and deployment. Issues such as inadequate real-time data and suboptimal decision-making are negatively impacting performance efficiency, highlighting the need for more advanced technologies and improved data utilization.

A key problem identified is the shortage of drivers, which severely affects the optimal use and deployment of land vehicles. This labour shortage impedes timely resource utilization and requires immediate remedial action to ensure that vehicles are adequately deployed when needed. Addressing this shortage is crucial for enhancing operational effectiveness.

Technological advancements, such as data analytics and predictive maintenance systems, are critical for improving vehicle optimization and reducing operational downtime. However, the organization faces a gap in technological skills

among its workforce, which hinders the effective implementation of AI-driven systems. Investing in training and development for these technologies is essential for maximizing their benefits.

Finally, the research highlights the importance of Standard Operating Procedures (SOPs) in improving operational efficiency and communication within RMAF. Effective coordination between departments is vital for successful fleet management and mission execution. Although financial constraints are a barrier to adopting new technologies, their long-term benefits in reducing costs and enhancing efficiency make them a valuable investment. The overall recommendation is to focus on technological upgrades, workforce training, and improved management processes to optimize fleet management at RMAF.

5.2 Discussion

The discussions of the conclusion are presented according to the research objective. As such, this section first elaborates the relationships between operational challenges, utilisation of technology and driver training and evaluation performances.

5.2.1 Objective 1: Investigate appropriate technological solutions that can enhance fleet management.

The first objective is coherently linked with chapter 4 and it represents the improving fleet management process by utilizing telematics, predictive maintenance and time tracking. Telematics and GPS tracking can provide valuable data for optimizing operations, enhancing decision-making, and ensuring vehicle security. Predictive maintenance systems can streamline maintenance cycles, reducing operational downtime and costs while increasing overall efficiency.

The adoption of data-driven decision-making and advanced software solutions can significantly boost fleet management performance. Technologies such as AI-driven video telematics can improve route optimization and operational efficiency, while real-time tracking systems offer better insights and safety for military operations. Effective use of these technologies not only enhances operational effectiveness but also helps in managing the extensive working hours of employees by reducing stress and increasing productivity.

To fully leverage these advanced technologies, RMAF must develop and implement updated training programs for its workforce. The transition from traditional systems to new technological solutions requires proper training to ensure that staff can effectively use the new tools. Although RMAF's current infrastructure and workforce may not fully align with the advanced technologies, investing in updated training and technology will be crucial for optimizing fleet management, improving operational efficiency, and ensuring cost-effectiveness in the long term.

5.2.2 Objective 2: Examine external and internal operational factors affecting vehicle utilization.

Objective 2 focuses on examining both external and internal factors that affect vehicle utilization in fleet management. Effective fleet management requires addressing mission requirements, ensuring safety, and maintaining cost efficiency. Key operational factors include tracking real-time vehicle locations, managing fuel usage, and ensuring proper scheduling of operational staff. By using GPS and telematics, RMAF can enhance vehicle safety, optimize fuel consumption, and improve overall operational effectiveness.

Proper vehicle maintenance, including the replacement and reutilization of parts, further contributes to operational efficiency and environmental sustainability. Effective scheduling and coordination among operational staff are crucial for maintaining harmony in fleet management. By optimizing these processes, RMAF can enhance worker motivation, reduce operational costs, and improve service delivery. Overall, integrating advanced technologies and efficient management practices will help RMAF achieve better safety, cost management, and mission effectiveness.

5.2.3 Objective 3: **Evaluate the effectiveness of current training programs within the RMAF for land transport resource management**.

Objective 3 evaluates the effectiveness of current training programs within RMAF for managing land transport resources. The research reveals that the existing training programs are insufficient for addressing fleet management challenges and improving performance. Although the drivers and technicians are adequately trained for basic vehicle operation, the training does not significantly impact the overall efficiency or cost-effectiveness of fleet management.

The research highlights that advanced technologies and real-time data are crucial for optimizing fleet management and making informed decisions. Despite the current level of training, the lack of technical skills among the workforce hinders the effective implementation of these technologies. Advanced systems like GPS tracking and predictive maintenance could enhance fleet performance, but their benefits are limited by the current training structure and technological skills of the personnel.

To improve fleet management, RMAF needs to enhance both technological infrastructure and workforce training. Effective training programs should be introduced alongside the implementation of advanced technologies to

ensure that personnel can fully utilize these tools. This will help in minimizing operational issues, improving performance efficiency, and achieving cost-effectiveness in fleet management.

5.3 Recommendation

Fleet management is essential for addressing operational challenges faced by RMAF and modernizing its military functions. The research indicates that RMAF's current vehicle tracking systems are outdated and less efficient, leading to suboptimal vehicle performance. To improve monitoring and efficiency, the implementation of Artificial Intelligence (AI) is recommended. AI can enhance real-time data access, allowing for better fleet utilization and informed decision-making.

AI-driven systems will enable RMAF to more accurately assess ground conditions and manage fleet capacity. By utilizing real-time data, these systems can adjust workloads and respond effectively during emergencies. The advanced algorithms in AI tools offer improved data interpretation, which is crucial for timely and effective responses, ultimately enhancing the safety and security of the country. The RMAF can significantly enhance its fleet management through AI-driven monitoring systems that provide real-time data on the maintenance needs of vehicles and hardware. By leveraging this data, RMAF can effectively identify which vehicles require immediate maintenance, allowing for better segmentation between operational and non-operational vehicles. This approach not only optimizes the fleet's performance but also improves the planning and execution of military operations, reducing the likelihood of errors and increasing mission success rates (Pillah, 2024; Bathla et al., 2022).

While financial constraints have been identified as a challenge in implementing AI within RMAF's fleet management, the long-term cost efficiency of digital tools makes them a viable solution. Initially, AI-driven tools can be selectively applied to specific management processes, gradually expanding as resources allow. This phased adoption minimizes human error and simplifies the overall management of vehicles, making the fleet more reliable and effective in the long run (Litvinenko, 2020).

The issues faced by RMAF also include inadequacy of technological skills among its workforce, which hampers effective resource utilization and operational efficiency. To address this, RMAF should implement regular technological training for its employees, ensuring they can effectively operate advanced systems. This would enhance the overall performance of military operations by reducing errors and increasing workforce competency, ultimately leading to more successful missions (Boon-Jong, 2021).

Additionally, RMAF must prioritize the safety of both its data and vehicles by adopting advanced technological measures. Given the higher risks associated with military vehicle operations, the use of video telematics is recommended to assist the blind spot detection,can help assess road conditions and improve risk management. Implementing such safety protocols would allow drivers to make informed decisions, thereby reducing uncertainties and enhancing the performance of RMAF's land vehicles (Masello et al., 2022).

The implementation of the advanced technologies while replacing traditional data processing systems will help RMAF to address the operational optimisations to a great extent in the case of fleet management. The Royal Malaysian Air Force (RMAF) can significantly enhance fleet management by replacing traditional data processing

systems with advanced technologies. These technologies enable real-time data-driven decision-making, leading to more accurate and efficient management processes with fewer errors. By upgrading both infrastructure and technological skills, RMAF can better identify and address underlying issues affecting vehicle performance, ultimately improving overall operational efficiency (Tanaka et al., 2020).

Efficient management of traffic and weather data is also crucial for RMAF's land vehicle operations. Providing real-time traffic information to drivers allows for informed decision-making, enabling dynamic routing that minimizes delays and ensures timely completion of military missions. The collaboration between advanced technologies and a skilled workforce is key to optimizing resource utilization, reducing operational costs, and enhancing the effectiveness of RMAF's fleet management. Continuous technological skill development among the workforce will further contribute to the sustained operational success of RMAF (Jenkins, Robbins & Lunday, 2021).

The RMAF can enhance logistics efficiency and reduce costs by forming alliances with other agencies and other military branches to share resources, such as transport and infrastructure. These collaborations can optimize utilization rates and decrease overall logistics expenses. Additionally, RMAF can take a proactive stance on environmental sustainability by adopting green aviation practices like using sustainable aviation fuels and energy-efficient technologies. These initiatives not only reduce the carbon footprint but also improve RMAF's reputation as a responsible organization that adheres to global environmental standards (Yaacob & Pero, 2023).

Strategic planning and forecasting are essential for effectively allocating resources and meeting future operational needs, such as military missions and disaster relief efforts. By using data analytics and historical performance data, RMAF can

ensure that transportation resources are deployed efficiently. Maintaining high safety and compliance standards through regular audits, inspections, and safety exercises is crucial for operational reliability. Encouraging a culture of continuous improvement and creativity among transport staff will further enhance resource optimization. Implementing these strategies will lead to financial savings, improved operational effectiveness, and sustained readiness for various missions, ultimately boosting the RMAF's logistics capabilities and overall mission success (Mudassir et al., 2023).

5.4 Implication of Research

The findings of this study provide valuable insights into enhancing decision-making processes within fleet management, particularly in addressing operational challenges. By leveraging advanced technologies such as AI and telematics, fleet managers can utilize real-time data to make more accurate and timely decisions regarding vehicle maintenance, resource allocation, and operational planning. This data-driven approach is expected to increase operational efficiency, minimize downtime, and maximize the utilization of available resources, ultimately leading to cost reductions. Moreover, identifying and addressing operational challenges such as resource limitations, inefficiencies, and logistical bottlenecks can further streamline fleet management practices.

Furthermore, the adoption of data-driven decision-making and advanced software solutions, such as AI-driven video telematics, can significantly improve route optimization and operational effectiveness. Real-time tracking systems offer enhanced insights and safety for military operations, while also helping to manage extensive working hours for employees, reducing stress, and increasing productivity. This comprehensive approach to technology utilization positions organizations favourably

in an increasingly eco-conscious market and aligns with global sustainability standards.

Lastly, the study highlights the significance of driver training in optimizing fleet operations. Well-trained drivers equipped with the skills to interpret real-time data and utilize advanced technologies are essential for ensuring safe and efficient operations. Accurate forecasting of transport demand and resource allocation, supported by data analytics, can better prepare organizations for future challenges, ensuring readiness for both routine operations and unexpected scenarios. This proactive approach to fleet management, combined with a focus on driver training, can lead to improved safety standards, increased reliability, and the ability to scale operations effectively across different fleet sizes and types.

5.5 Limitation of Research

This study focuses on improving fleet management and vehicle utilization within the RMAF. One of the primary limitations is the small sample size used for the research, which may not fully represent the broader population associated with RMAF's fleet operations. This limitation can affect the generalizability of the findings, as the insights drawn may not capture the diversity of experiences and opinions across the entire organization.

Additionally, concerns regarding data security posed a significant challenge. Given the sensitive nature of military operations, there were restrictions on accessing certain information, leading to potential gaps in the data collected. This limitation also influenced the depth of analysis, as the researcher had to ensure that all data handling complied with strict security protocols, which may have constrained the scope of the research.

5.6 Future scope

Future research should prioritize the use of large datasets to deepen the understanding of fleet management and vehicle utilization in military operations like the RMAF. Large-scale studies are crucial for accurately quantifying how key barriers impact operational efficiency and costs. The inclusion of extensive data would also support the development of realistic simulations to model complex fleet networks, predict potential disruptions, and offer strategies for mitigation.

Additionally, analysing large datasets would enhance the evaluation of fleet information systems, allowing for a more comprehensive assessment of metrics such as data latency, system administration ease, and user satisfaction. This would lead to better-informed decisions on system upgrades and innovations. Moreover, comparing data from both small and large fleet operators would enable researchers to identify size-specific challenges and develop effective digitalization strategies. By integrating large-scale data, future research can provide a stronger empirical foundation for advancing fleet management practices.

5.7 Conclusion

In summary, this study has highlighted crucial insights into optimizing land transport resources for the RMAF through cost-efficient fleet management strategies. The research underscores that integrating emerging technologies such as telematics, artificial intelligence (AI), and the Internet of Things (IoT) can significantly enhance fleet management effectiveness and operational efficiency. Key findings from the study reveal that the adoption of these technologies addresses major operational challenges faced by the RMAF, including inefficient vehicle allocation, limited real-time tracking, and outdated reactive maintenance practices. By leveraging these

advancements, the RMAF can achieve a more agile and cost-effective fleet management system, which is essential given the evolving geopolitical landscape and budget constraints.

While the findings offer actionable recommendations for improving fleet management practices, further research is needed to explore the long-term impacts of these technologies and gather data from diverse operational contexts. Additional studies could include longitudinal analyses and external data sources to provide a more comprehensive understanding of the benefits and challenges of these technologies in different scenarios.

Overall, this research establishes a positive correlation between advanced fleet management techniques and operational performance, offering valuable guidance for the RMAF. By implementing the suggested strategies, the RMAF is well-positioned to enhance its fleet management practices, thereby strengthening its operational readiness and strategic capabilities in the face of financial and geopolitical challenges.

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QUESTIONARIES

Optimising Land Transport Resources: Improving Fleet Management Using Cost Efficiency Effectiveness

Dear Respondents,

My name is Maj Noorhafizan bin A. Talib RMAF. I am a Master's student at the University of Utara Malaysia (UUM). I am currently in my final semester and conducting my final year project (thesis). Assoc. Prof. Ts. Dr. Nur Khairiel bin Anuar supervised my research on topic " **Optimising Land Transport Resources: Improving Fleet Management Using Cost Efficiency Effectiveness**."

Thank you in advance for participating in my research study. Your valuable insights are crucial to my research. The questionnaires is about a short demographic about the respondent and Fleet Management & Vehicle Utilisation in RMAF organization. Please take a few minutes to complete the following questionnaires, providing honest and thoughtful responses. Your feedback will greatly contribute to the success of my research.

Your privacy is important to me. We will treat all the information you provide in the questionnaires with the utmost confidentiality. Please feel free to express your opinions openly and honestly. Thank you.

Maj Noorhafizan bin A. Talib RMAF

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013-3573479

Appendix 1

QUESTIONARIES

Optimising Land Transport Resources: Improving Fleet Management Using Cost Efficiency Effectiveness

Section A: Demographic

Please tick the answer

1. What is your race?

Malay	
Chinese	
Indian	
Others	

2. What is your age group?

Under 20	
21-30	
31-40	
41 and over	

3. What is your marital status?

Single	
Married	
Others	

4. What is your highest level of education achieved?

Secondary School	
Diploma	
Bachelor's degree	
Master's Degree and above	

5. What is your designation?

OIC/SNCO IC	
NCO IC	
Driver	
Others	

6. How long have you served in RMAF?

1-5 years	
5.1 to 10 years	
10.1 to 15 years	
15.1 to 20 years	
> 20 years	

Section B (Independent Variables)

(Please indicate the appropriate response by circling it).

Operational Challenges	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1. RMAF's fleet management system is effective to optimizing vehicle utilization?	1	2	3	4	5
Q2. Managing RMAF's land transport resources is challenging in					
a. Vehicle Maintenance Issues	1	2	3	4	5
b. Timely Deployment for Missions	1	2	3	4	5
c. Driver Shortage	1	2	3	4	5
d. Fuel Management	1	2	3	4	5
Q3. Operational challenges will impact the deployment time for RMAF missions?	1	2	3	4	5
Q4. The current RMAF maintenance procedures is satisfied?	1	2	3	4	5
Q5. RMAF's fleet management and vehicle utilization facing a new challenges and need improvements?	1	2	3	4	5
Q6. Data analytics can optimize vehicle utilization and reduce operational downtime within RMAF?	1	2	3	4	5
Q7. Predictive maintenance can optimise vehicle utilisation and reduce operational downtime within RMAF	1	2	3	4	5

Utilisation of Technology	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q8. Integrating technology is crucial to improve fleet management and vehicle utilization within RMAF.	1	2	3	4	5
Q9. The current technological tools and software used is satisfied for fleet management within RMAF.	1	2	3	4	5
Q10. Upgrading technology infrastructure could help address operational challenges in fleet management.	1	2	3	4	5
Q11. Main Obstacles hindering the effective implementation of advanced technology solutions for fleet management in the RMAF.					
a. Budget constraints	1	2	3	4	5
b. Lack of technical expertise	1	2	3	4	5
c. Resistance to change from personnel	1	2	3	4	5
d. Integration issues with existing systems	1	2	3	4	5

Driving Training & Evaluation Performance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q12. All RMAF drivers is adhering to operational protocols and safety standards.	1	2	3	4	5
Q13. Current driver training programs offered within RMAF is satisfied	1	2	3	4	5
Q14. Implementing advanced driver training programs could help mitigate operational challenges and enhance vehicle utilization.	1	2	3	4	5

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q15. Current methods of evaluating RMAF drivers' proficiency in handling domestic vehicles and equipment is effective.	**1**	**2**	**3**	**4**	**5**
Q16. RMAF's driver training programs require enhancements to effectively tackle fleet management challenges.	**1**	**2**	**3**	**4**	**5**
Q17. The quality of driver training programs has a strong correlation with overall fleet performance within the RMAF	**1**	**2**	**3**	**4**	**5**

Section C (Dependable Variable)

(Please indicate the appropriate response by circling it).

Cost Effectiveness & Efficiency	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q18. Data regarding vehicle maintenance schedules and repair history within RMAF are transparent and accessible.	**1**	**2**	**3**	**4**	**5**
Q19. Standard Operating Procedures (SOPs) can contribute to efficient fleet management and vehicle utilization in RMAF	**1**	**2**	**3**	**4**	**5**
Q20. RMAF utilize data analysis to identify trends, patterns, and areas for improvement in fleet management and vehicle utilization effectively.	**1**	**2**	**3**	**4**	**5**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q21. Vehicle usage and deployment within RMAF can be track and monitor by:					
a. Manual logs and records	1	2	3	4	5
b. Spreadsheets or basic software	1	2	3	4	5
c. Dedicated fleet management software	1	2	3	4	5
d. GPS tracking systems	1	2	3	4	5
Q22. Regular assessments and audits conducted to ensure compliance with risk management policies and regulations in your workplace.	1	2	3	4	5
Q23. Overall coordination and communication between different units involved in RMAF's fleet management is satisfy	1	2	3	4	5

Thank you for taking the time to share your valuable insights with us. Your thoughtful responses are instrumental in shaping our research. I truly appreciate your participation, and your input will contribute significantly to the success of my study.

Rest assured that all the information you provided in this questionnaire will be treated with the utmost confidential. Thank you for your time and valuable contribution.