Asian Business Research Journal
Vol. 9, 135-140, 2024
ISSN: 2576-6759
DOI: 10.55220/25766759.232

Effect of Fleet Vehicle Tracking on Operational Performance of Road Transporters in Mombasa County

Nancy N. Kinyua[1]
Wickliffe Arani[2]
Mathew M. Egessa[3]

[1]*Department of Management Science, Technical University of Mombasa, Kenya.*
Email: nancykinyua593@gmail.com
[2]*Multimedia University, Malaysia.*
Email: Arani@mail.com
[3]*Technical University of Mombasa, Kenya.*
Email: Egessa@mail.com
(✉ Corresponding Author)

Abstract

This study examines the effect of vehicle tracking on the operational performance of road transporters in Mombasa County. Effective fleet management, and specifically vehicle tracking, is essential for optimizing resources, reducing costs, and improving efficiency in transportation operations. Guided by the Technology Diffusion Theory, the study employs a descriptive research design and targets 250 registered road transport companies in Mombasa County, selecting a sample of 154 participants through stratified random sampling. Data were collected using structured questionnaires and analysed with descriptive and regression techniques. The findings indicate that vehicle tracking significantly enhances operational performance, evidenced by a positive unstandardized coefficient of 0.459 and a p-value of 0.000. Key practices, including speed monitoring, route management, and real-time vehicle dispatch tracking, were identified as crucial contributors to this improved performance. The study concludes that vehicle tracking systems foster accountability, decrease fuel consumption, and boost overall productivity. Recommendations include the implementation of advanced GPS tracking technology, regular maintenance of tracking systems, and comprehensive staff training to maximize the benefits of vehicle tracking for operational efficiency. This research enhances the understanding of how technology can be utilized to tackle challenges in fleet management, particularly in developing regions.

Keywords: Fleet management, GPS tracking, Operational performance, Road transporters, Vehicle tracking, Logistics.

1. Introduction

Fleet management plays a pivotal role in optimizing the use of resources, minimizing transportation costs, and ensuring regulatory compliance for businesses that depend on transportation. It incorporates various practices such as maintenance, fuel management, vehicle replacement, safety management, and driver oversight to enhance operational efficiency and agility. By addressing challenges like mechanical faults, safety risks, and inefficient logistics systems, fleet management aims to boost customer satisfaction and organizational performance. Rojas et al. (2020) noted that fleet management has resulted in a large number of American enterprises that primarily depend on transportation to minimize or eliminate the risk associated with human expenditures and procedures. Real-time fleet tracking is one feature of fleet management that can save fuel and overhead expenses while also enhancing safety and monitoring (Cronbach, 2021).

Fleet management entails making sure that a fleet's use of resources, total transportation costs, and regulatory compliance are all at their best. It is a crucial component of logistics operations. Increasing revenue, enhancing customer satisfaction, and giving a fleet more agility, all depend on these actions. Various fleet management practices, including maintenance, fuel management, vehicle replacement (Milenković, Knežević, & Bojović, 2020), safety and vehicle drivers' management (Sun et al., 2021), and vehicle routing (Makarova, Gabsalikhova, & Gritsenko, 2020; Adam, 2020), can be included in fleet management (FM). With a large number of vehicles operating along distribution networks with numerous mechanical faults, which endangers the supply chain and impairs organizational performance, the fleet management function is not doing well globally. According to Chiparo et al. (2022), companies should incorporate car maintenance into their business strategy holistically to enable them to react swiftly to the needs of their clients.

In the Ghanaian transport sector within the Kumasi metropolis, Aflabo, Kraa, and Agbenyo (2020) evaluated the effect of fleet management practices on competitive advantage. They discovered that while vehicle tracking has an inverse relationship with competitive advantage, repair and maintenance, fuel and driver management, and training have positive effects. Vehicle and driver tracking, asset management, efficient communication, time and driver management, post-sale services, and customer relationship management are essential elements of fleet management (Amaya & Abdullah, 2021). A number of elements are taken into consideration by fleet management, such as asset tracking, speed management, fuel management, health and safety management, driver scheduling and rostering, vehicle finance, maintenance, and telematics. Fleet management's primary goals are to reduce personnel

and transportation costs, increase productivity and efficiency, and successfully mitigate the risks connected with vehicle operation.

Abdirahman et al. (2024) outlines the limitations of the vehicle tracking system in Ethiopia, which include a shortage of vehicles for transporting goods, a poorly functioning logistics system that hinders market potential, a high incidence of traffic accidents, particularly in relation to goods transport, and congestion in cities and at entry and exit points.

Fleet management is integral to logistics operations, offering numerous benefits such as cost reduction, increased productivity, and risk mitigation. However, challenges persist, such as mechanical faults, inefficient logistics systems, and traffic congestion, as noted in various studies. By integrating practices like vehicle tracking, maintenance, and driver management into a holistic strategy, businesses can strengthen their supply chain performance and competitive advantage. Addressing these challenges, particularly in regions like Ghana and Ethiopia, can further enhance the overall effectiveness of fleet management in fostering sustainable growth.

2. Literature Review

2.1. Technology Diffusion Theory

Technology diffusion theory, developed by Rogers (1962), focused on appreciating the manner in which innovation and technology diffuse within a social pattern. It explains how, why, and the rate at which a product, service, or process spreads through a population or social system. The process of making innovative decisions consists of five steps: knowledge, persuasion, decision, implementation, and confirmation. The rate at which vehicle tracking technology spreads among road transporters can be explained through technology diffusion theory. In technology diffusion theory, it's not individuals who adjust, but the innovations in which changes occur in fleet management among the road transporters (Masumbuko & Phiri, 2024).

Diffusion is the process through which certain channels of modernization are transmitted over a period of time amongst the social system members (Kurt, 2022). According to him, diffusion is the manner by which a technology diffuses through a society of fleet management. Therefore, diffusion as a concept implies the dissemination of technology from a focal point or organization in the society to other areas of that particular group. Despite its wide application and acceptance, criticisms of technology diffusion theory are evaluated by components of the theory that should be developed and adjusted before being applied in technology transformation.

Alabbasi and Sandhu (2021) found that an innovation does not necessarily need to experience various phases of reception for a person to adjust to it as proposed by the hypothesis. At times adoptions were conveyed in dyadic relationships, and it was very hard to identify the stages of adoption. Want, (2006) Created a system that tracks and monitors automobiles in the cold chain using RFID technology. The influence of vehicle tracking on road carriers' operational efficiency is explained using the principles of radio frequency identification, or RFID. In fleet management, a decision support system that makes use of RFID technology to supervise, trace, and monitor items was presented. From the perspective of shippers, Amankwah-Sarfo (2020) looked at the critical factors that affect the acceptability of a container security service that uses RFID technology and auto-detection.

Another option relies on cellular infrastructure. Cellular infrastructure is leveraged by network overlay systems to pinpoint the exact position of automobiles. In order to determine the exact location of the cars, the cell centers use additional hardware and software to assess the time of arrival (TOA) and angle of arrival (AOA) of radio signals sent by the vehicles. This data is transmitted to the tracking center using a regular link or a cellular connection. Another method employed for determining the location of automobiles involves calculating the time discrepancy between signals transmitted from two cellular towers and received by the vehicle. This theory explains the use of technology in modern vehicle tracking. At present, the majority of road transporters are utilizing GPS-enabled devices to monitor vehicles during transit. The GPRS tracker keeps track of the vehicles' speed and whereabouts around the clock.

2.2. Conceptual Framework

Vehicle tracking is the process of tracking a moving vehicle by using smart tags or barcode scanning. Vehicle tracking is possible with devices that integrate satellite or cellular network technology with the Global Positioning System (GPS). The way the vehicle tracking system is designed makes it easier to manage the entire fleet by keeping track of all the goods and tangibles that are loaded into or assigned to drivers. Information systems used to coordinate and route services in the field have a positive effect on a fleet's performance and regular growth, claim Milenkovic, Milos, & Bojovic (2020).

The fields of logistics and transport commonly employ vehicle tracking, primarily for theft prevention. These systems utilize GPS technology to deliver accurate and continuous location telemetry to fleet management. These systems usually come with capabilities that can track statistics such as fuel usage, average speed, current driver time, and position. Rules imposing stricter limits on the number of hours' drivers can work in a single day have recently led to a surge in demand for this technology (Smilowitz & Balcik, 2021).

Automobile manufacturing technology has evolved to prioritize the development of features that enhance safety, comfort, and convenience rather than only focusing on fundamental transportation. The GPS application tracks the distance travelled during a journey, vehicle mileage, and speed. The system can maintain a log of driving activities, which includes the addresses of each destination, the names of the streets travelled, and the duration of the vehicle's stay at each site. This allows owners to monitor the usage of their vehicles by other drivers (Singh & Kathuria, 2021).

However, fleet management has a significant effect on the operational performance of road transporters. It enables fleet managers and users to efficiently and effectively carry out their activities by utilizing technologies like the Internet and Global Positioning Systems (GPS). The administration of road transport, particularly fleet management, necessitates the utilization of sophisticated technology to enhance the transportation information system (Mehmood, 2021).

The potential commercial advantages of vehicle tracking extend across all sectors of fleet management and types of vehicles. More asset management, better customer service, more efficient load placement, more accurate timesheets, and easier compliance with Working Time Directive regulations are the main advantages for haulage fleets. According to Mullani (2021), vehicle tracking systems have the potential to improve work planning and allocation for van fleets, resulting in higher staff productivity.

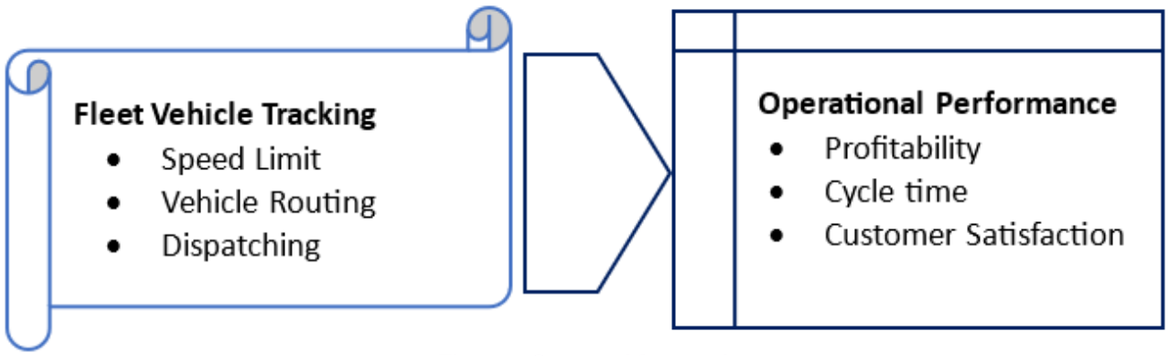

Figure 1. Conceptual framework.

The conceptual framework in Figure 1 demonstrates the relationship between fleet vehicle tracking and operational performance. Fleet vehicle tracking encompasses key practices such as monitoring speed limits, optimizing vehicle routing, and effective dispatching. By ensuring vehicles operate within designated speed parameters, organizations can improve safety, reduce fuel consumption, and enhance overall efficiency. Vehicle routing focuses on identifying the most optimal routes to minimize travel time, reduce transportation costs, and ensure timely deliveries. Additionally, dispatching ensures effective coordination of vehicle assignments, enabling timely operations and improved resource utilization.

These fleet tracking practices are designed to enhance operational performance, which is measured through key outcomes such as profitability, cycle time, and customer satisfaction. Profitability is achieved through cost reductions and improved operational efficiency, while shorter cycle times result from streamlined processes and reduced delays (Ochoki et al., 2023). Moreover, enhanced vehicle tracking contributes to improved customer satisfaction by ensuring timely deliveries and consistent service quality. Overall, the framework highlights how effective fleet vehicle tracking can positively influence operational performance, leading to greater organizational success.

2.3. Empirical Review

The effect of fleet management on a transport business that manages Taiwan's biggest shipping line is examined by Begashaw and Temesgen (2019). This business is a division of a well-known food and retail conglomerate, which is Taiwan's largest chain store group. The research is empirical in character. In order to increase the company's competitiveness in the market and achieve the objectives set by the company, the case serves as a point of reference for the unsuccessful results of introducing electronic operations and systems. It was anticipated that the company's operating efficiency would rise as a result of these solutions. The study found that GPS-based fleet management solutions are extremely important for the logistics industry, especially for transportation companies. These systems allow for commodity distribution monitoring and tracking, resulting in energy savings. Furthermore, the solutions also enhance scheduling, operational efficiency, and effectiveness. The significance of fleet management systems has made their successful implementation a crucial concern (Bask et al., 2019).

Besiou, Pedraza Martinez, and Van Wassenhove (2022) asserted that initial fleet management systems had basic features, such as vehicle tracking components. These systems have transformed into planning tools due to increased management sophistication. The functionality of vehicle tracking and vehicle maintenance systems differs from that of fleet management. Fleet management includes the oversight of vehicle usage and maintenance, as well as the coordination and dissemination of tasks and relevant information to address the complex challenges of scheduling and routing vehicles (Belachew, 2022). Vehicle tracking, fleet management, and monitoring widely utilize GPS technology products. To achieve optimal utilization and quick responses to customer demands, the existing asset management systems require continuous monitoring and interaction with fleet vehicles using advanced technology. Effectively managing a fleet of vehicles requires skillful navigation of increasing fuel prices, escalating maintenance expenses, and crucial safety considerations, all while maintaining a steadfast dedication to providing exceptional customer service (Chaharbaghi et al., 2021).

Begashaw and Temesgen (2019) assert that utilizing a vehicle tracking system enables customers to effectively manage their expectations and adjust their delivery times, thereby assisting fleet management in efficiently planning their deliveries. We evaluate fleet management based on its capacity to enhance firms' efficiency and profitability. Ambrisko and Teplicka (2021) acknowledged the significance of an efficient vehicle maintenance strategy as a crucial factor for the successful operation of transportation-related functions. In order to ensure optimal performance, it is imperative that fleet maintenance and management procedures incorporate effective tactics into their daily operations. This should involve the efficient allocation and management of resources to enable road transport companies to achieve a competitive edge. The biggest issue in fleet management practices among road transporters is the lack of a maintenance scheme that guarantees the efficiency, productivity, and safety of vehicles and drivers (Chikwere & Kanyepe, 2020).

3. Methodology

The study employs a descriptive research design to explore the nature and impact of fleet management on organizational performance, specifically within the telecom sector as a case study. Descriptive research, as defined by Shane (2023), aims to assess the current state of a phenomenon and its relationship with specific components or conditions. The target population comprises 250 registered road transport companies in Mombasa County, Kenya, as identified by the Kenya Transporters Association (KTA). Stratified random sampling, which minimizes bias by giving each member an equal chance of selection, was used to determine the sample size. Based on Slovin's Formula, the sample size for the study is calculated to be 154 participants, with respondents distributed proportionately across Mombasa sub-counties, targeting one driver or logistics manager from each firm.

Primary and secondary data were collected using self-administered questionnaires, designed with Likert scale and closed-ended questions for easier coding, tabulation, and data comparison. The questionnaire, divided into two sections, addresses the study objectives by gathering general participant information in Section A and exploring the effect of fleet management on productivity in Section B. This method is advantageous for collecting large volumes of data quickly and cost-effectively while preserving confidentiality and avoiding bias. To ensure comprehensive and unbiased responses, the questionnaire follows a funnel approach, starting with general questions before transitioning to specific ones related to the study's variables.

4. Research Findings

4.1. Descriptive Results

The first objective was to examine the effect of Vehicle Tracking on operational performance. Vehicle Tracking was then established using the justification that a mean score of three in Likert scale represents neutral positions with the statement, mean score of less than three represents negative view of the statement and greater than three signifies a favourable view with the statement. The following was the range of interpretation for the mean score on the Likert scale: 1.0-2.4 (Disagree), 2.5-3.3 (Neutral), and 3.4-5.0 (Agree). Table 1 presents the results

Table 1. Vehicle tracking descriptive statistics.

	N	Minimum	Maximum	Mean	Std. deviation
Vehicle tracking software for speed limit monitoring is applied by the organization	122	1.0000	5.0000	3.918033	0.9924522
The supervisor checks out the speed monitoring software hourly basis	122	1.0000	5.0000	4.352459	0.8422925
The speed limit gargets installed in the vehicle is serviced regularly	122	1.0000	5.0000	3.786885	1.1224936
The vehicles are fitted with GPRS gadgets to show the location	122	1.0000	5.0000	4.090164	1.0523810
The company sets pre-defined routes for every vehicle on transit	122	1.0000	5.0000	4.155738	0.8909137
Any deviation from pre-defined routes is properly authorized	122	1.0000	5.0000	3.795082	1.0751784
The organization has a systematic way of confirming validity of every vehicle dispatch	122	1.0000	5.0000	4.000000	0.8528029
The organization monitors any delay on vehicle dispatch	121	2.0000	5.0000	4.107438	0.8041730
The organization confirms if the recipient received the consignment on time	122	3.0000	5.0000	4.016393	0.7494748
Vehicle tracking	122	2.3333	5.0000	4.020947	0.6305380
Valid N (Listwise)	121				

The descriptive statistics presented in Table 1 provide valuable insights into the effectiveness and application of vehicle tracking systems within an organization. The data encompasses responses from 122 participants regarding various aspects of vehicle tracking, measured on a scale from 1 to 5, where 1 indicates strong disagreement and 5 indicates strong agreement.

Respondents generally agree that the organization applies vehicle tracking software for monitoring speed limits, as reflected by a mean score of 3.92. The standard deviation of 0.99 indicates a moderate level of consensus among respondents, suggesting that while many believe this system is in place, some variability exists in their perceptions. Furthermore, there is strong agreement that supervisors check the speed monitoring software on an hourly basis, as indicated by a mean score of 4.35 and a standard deviation of 0.84. This finding highlights the diligent oversight and commitment to maintaining vehicle speed regulations within the organization.

Regarding the regular servicing of speed limit gadgets, the mean score of 3.79 suggests that respondents somewhat agree that these gadgets are consistently maintained. However, the standard deviation of 1.12 indicates a wider range of opinions, implying that some respondents may feel this practice is not always enforced. Additionally, the mean of 4.09 indicates general agreement that vehicles are equipped with GPS gadgets to display their locations, although the standard deviation of 1.05 shows moderate variability in responses. This reflects a positive outlook on the organization's capability to track vehicle locations.

Respondents also strongly agree that the company sets pre-defined routes for vehicles in transit, as demonstrated by a mean score of 4.16 and a standard deviation of 0.89. This suggests that establishing operational procedures for routing is a standard practice within the organization. Conversely, a mean of 3.80 indicates some agreement that any deviation from these pre-defined routes is properly authorized. The standard deviation of 1.08 shows variability in responses, suggesting differing views on the authorization process.

The mean score of 4.00 indicates general agreement that the organization has a systematic approach to confirming the validity of vehicle dispatches, with a standard deviation of 0.85 suggesting consistency in responses. Additionally, a mean of 4.11 reflects strong agreement that the organization monitors delays in vehicle dispatches, although a lower sample size of 121 indicates that this aspect may have been less frequently reported. Respondents also agree that the organization confirms whether recipients receive their consignments on time, with a mean score of 4.02 and a standard deviation of 0.75 indicating a relatively consistent response regarding this area of vehicle tracking.

Generally, the vehicle tracking practices within the organization are viewed positively, as indicated by the overall mean score of 4.02. This suggests that respondents generally perceive the systems and procedures in place as effective, with a standard deviation of 0.63 showing low variability, which indicates that most respondents share similar views. In summary, the descriptive statistics reveal that the organization has established strong vehicle tracking practices, particularly regarding speed monitoring and route management. While respondents generally agree on the effectiveness of these practices, some areas, such as the regular servicing of speed limit gadgets and the authorization of route deviations, show variability in opinions. The results are in line with Ambrisko and

Teplicka (2021) who acknowledged the significance of an efficient vehicle maintenance strategy as a crucial factor for the successful operation of transportation-related functions. This suggests potential opportunities for improvement in these areas. Overall, the data indicate a well-implemented vehicle tracking system that contributes to operational efficiency and accountability within the organization.

4.2. Regression Analysis and Hypothesis Testing

The Table 2 below presents the results of a regression analysis examining the effect of vehicle tracking on operational performance. The analysis includes unstandardized coefficients, standardized coefficients, t-values, and significance levels to evaluate the relationship between the independent variable (vehicle tracking) and the dependent variable (operational performance).

Table 2. Regression coefficients.

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. error	Beta		
1	(Constant)	0.858	0.300		2.860	0.005
	Vehicle tracking	0.459	0.058	0.532	7.953	0.000

Note: a. Dependent variable: Operation performance.

Vehicle Tracking indicates a significant positive effect on Operation Performance, with an unstandardized coefficient of 0.459. This means that for every unit increase in Vehicle Tracking, the Operation Performance improves by 0.459 units, holding all other variables constant. Its standardized coefficient (Beta) of 0.532 further highlights its dominant role among the variables. With a t-value of 7.953 and a p-value of 0.000, the relationship between Vehicle Tracking and Operation Performance is not only strong but highly statistically significant. These findings are in line with Begashaw and Temesgen (2019) who asserted that vehicle tracking system enables customers to effectively manage their expectations and hence significantly influence operational performance.

$H0_1$: Vehicle tracking has no significant effect on operational performance of road transporters in Mombasa County

The null hypothesis, H01 show that vehicle tracking has no significant effect on operational performance of road transporters was rejected. Implying that the effect of vehicle tracking affects the operational performance of road transporters in Mombasa County. These findings agree with the findings of Adebayo and Aworemi, (2021) who found that there is relationship between vehicle tracking and fleet management on operational performance in Yagba West of Kogi State, Nigeria.

4.3. Discussion of Study Findings

From the analysis of the study findings, it was noted that most of the respondents agreed that the organization applies vehicle tracking software for monitoring speed limits, as reflected by a mean score of 3.92. There is strong agreement that supervisors check the speed monitoring software on an hourly basis, as indicated by a mean score of 4.35 and a standard deviation of 0.84. The findings of the study showed that the regular servicing of speed limit gadgets, which was calculated and resulted in a mean score of 3.79 with a standard deviation of 1.12, indicates a wider range of opinions, implying that some respondents may feel this practice is not always enforced. The findings of this thesis showed that the respondents strongly agree that the company sets pre-defined routes for vehicles in transit, as demonstrated by a mean score of 4.16 and a standard deviation of 0.89, which suggested that establishing operational procedures for routing is a standard practice within the organization. Testing the hypothesis H01 indicated that vehicle tracking does not have a substantial impact on the operational performance of road transporters in Mombasa. These results are consistent with the findings of Adebayo and Aworemi, (2021), demonstrating a link between vehicle tracking and fleet management with operational performance.

5. Conclusion and Recommendations

Establishing the effect of vehicle tracking on the operational performance of road transporters in Mombasa County was the primary goal of this research project. From the finding of the research study, it was found that the company uses vehicle tracking software to assure efficiency and vehicle routing to regulate fuel consumption rate. The respondent said that an annual budget should be set aside for the upkeep and purchase of vehicle monitoring software so that the company can quickly address issues with vehicle tracking. The findings were noted that the company should provide training on fleet management through the use of vehicle tracking software and that using this software will increase accountability. The company uses cutting-edge GPS car tracking technology, allowing it to monitor the speed limit. With a mean of 4.71 and a standard deviation of 0.714, the respondents also concurred that the firm has installed vehicle tracking systems on all road transportation vehicles and designated a person to oversee and administer the GPS tracking system.

Based on the study's findings, the study concluded that organizations' fuel management systems work well when it uses vehicle tracking and monitoring software and this boosted the overall job productivity on operational performance of road transporters in Mombasa County. Based on the findings and conclusion of this thesis, the following recommendations were made: The research study recommended that the transportation department management in Mombasa County should implement vehicle tracking systems to enable the organizations' fleet managers to monitor speed limits through the GPS tracking. These systems should be permanently assigned to a person to monitor the speed limits of the road transporters online.

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