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DEVELOPMENT OF AUTOMOBILES' COMPUTERISED MAINTENANCE MANAGEMENT SYSTEM TO IMPROVE THE UDART'S BUSES AVAILABILITY PERFORMANCE:

CASE OF UDART HEADQUARTERS, DAR ES SALAAM

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Abstract
This study intended to develop Automobiles' Computerised Maintenance Management System (CMMS) to Improve UDART Buses' Availability Performance, Case of UDART Headquarters-Dar es Salaam. The specific study objectives were to assess factors affecting the availability performance of public service vehicles owned by UDART, to develop a CMMS model for improving the availability performance of public service vehicles owned by UDART, and to develop a CMMS for improving the availability performance of passengers' service vehicles owned by UDART. The theories adopted are Resource Based Theory, Institutional Theory and Human Capital Theory. The study used a cross-sectional survey design. The data collection process used structured questionnaires. The data collection process involved 71 respondents using simple random and purposive sampling methods. Data processing used the Statistical Package for Social Sciences version 26 program to estimate numerical values and descriptive statistics to indicate study results. Inferential and descriptive statistics tested relationships of study variables, comprising OLS multiple regression analysis, percentages, frequencies and correlations. Again, the study has brought an efficient maintenance management model to guide UDART and other passengers' transporters in running their firms productively. Finally, the resulting CMMS has revealed the significance of improving the availability performance of UDART's buses to 90.32%. Nevertheless, UDART should invest well in maintenance tools and equipment as they significantly affect the availability performance of the buses.

Keywords: Computerised Maintenance Management, Passengers Service, Availability Performance

INTRODUCTION

UDART, a public transport system, has 240 buses providing regular and express services. However, the company faces challenges such as prolonged waiting times and crowded buses, especially during peak hours. Proper maintenance management is crucial for UDART operations, as it helps retain the reliability and durability of vehicles.

As the population grows, the demand for passenger service vehicles increases, leading to traffic congestion, air pollution, and exhaust pollution.

The quality of service and the sustainability of the business require sufficient funding. Reliability of service is crucial for passenger access and customer satisfaction. Technical faults or breakdowns can lead to service disruptions, making it essential to prioritise maintenance and upkeep. Regular changes of engine oils, filters, and other failed parts are necessary to maintain vehicle condition, performance, and productivity. This study aims to develop a Computerised Maintenance Management System (CMMS) to enhance the availability performance of UDART buses.

NEED OF THE STUDY

UDART, a public transportation system, faces challenges due to unplanned downtime and decreased capacity. With 240 buses, the minimum availability performance is 85%. Overcrowded buses and long wait times, particularly during peak hours, contribute to fatigue and increased depreciation rates. This study aims to develop Automobiles Computerised Maintenance Management System (CMMS) to improve bus availability and service performance.

Objectives of the Study

The focus of the study will be on specific and primary objectives, which are:

Main Objective

The main objective of this study is to develop a computerised maintenance management system to improve the bus availability and service performance of UDART's fleet.

Specific Objectives

This study will rely on the following specifics to reveal its core objective;

i. To assess the factors affecting the availability performance of public service vehicles owned by UDART.
ii. To develop a mathematical model for improving the availability performance of public service vehicles owned by UDART.
iii. To develop a computerised maintenance management system for improving the availability performance of passengers' service vehicles owned by UDART.

Definition of Key Terminologies

Computerised Maintenance Management

According to Sharma (2019), maintenance involves repairing and fixing assets to ensure their functionality throughout their lifespan. Again, ISO 55000 emphasises benefits such as improved financial performance, risk management, product quality, social responsibility, compliance validation, and increased efficiency, Almeida (2022). Standard maintenance approaches include corrective, planned, preventive, and predictive maintenance. Computerised maintenance management systems (CMMS) simplify maintenance activities, increase the availability of physical assets, and improve productivity. CMMS manages technical specifications, locations, spare parts, maintenance history, work orders, materials, and performance indicators for report generation.

Availability Performance

Gueller et al. (2016) define *availability performance* as the probability of a system performing its intended function within specified conditions and time frames. High availability performance reduces maintenance costs, ensures safer production, and enhances a company's competitiveness. Alavian et al. (2019) use Mean Time to Repair and Mean Time Between Failures metrics.

Additionally, Kortelainen and Pursio (2001) and Jagtap et al. (2021) have highlighted that Equation 1 aids in calculating technical availability performance.

$$Tav = \frac{Tmax - Td}{Tmax} = \frac{Uptime}{Uptime + Downtime} = \frac{MTBF}{MTBF + MTTR)} \quad \text{..(1}$$

Where:
Tav = Technical availability performance
Tmax = Maximum operating time
Td = Downtime or maintenance time
MTBF = Mean Time Between Failures
MTTR = Mean Time to Repair

Factors Affecting Buses' Availability Performance
Asset availability results from designs, operations, and maintenance approaches, Kasimov et al. (2021). Again, proper maintenance reduces wear and tear, increases availability, and reduces depreciation rates, Jumbo et al. (2019). Regular inspections and maintenance programs optimise availability performance, improving productivity, safety, and pollution control. Fleet maintenance managers must consistently monitor fleet conditions to identify maintenance requirements, lower costs, and enhance availability performance, Olugu et al. (2021).

According to Feng et al. (2021), the availability of spare parts is directly related to maintenance cost management. Also, overloaded vehicles increase accident risks and tire overheating, threatening road traffic safety, Alkhoori and Maghelal (2021). Furthermore, Gerum et al. (2019) stated that excessive maintenance can lead to costly operations and losses. Thus, maintenance programs should strategize economic benefits and minimise downtime to optimise fleet availability. Similarly, CMMS can reduce unscheduled downtime and waiting times for technical staff and spare parts acquisition, Wroe et al. (2020).

Public Transport
Sukhov et al. (2022) pointed out that fleet operations management and stakeholder engagement are crucial for improving the Bus Rapid Transit service quality. Again, maintenance management is essential for assets, as it ensures customer satisfaction, increases availability and reliability, and reduces breakdowns, Olugu et al. (2021). It also helps in reducing fuel consumption and interruptions in organisational activities. Furthermore, Abbas et al. (2020) declared that asset managers and maintenance engineers are essential for effective project management. In addition, customer-oriented staff are crucial for providing the best possible service. Accordingly, good maintenance management reduces asset downtimes and repair costs, enabling efficient operation and increased profit. In that regard, this study developed a CMMS to improve the availability performance of UDART's buses, with 71 UDART staff participating in the data collection process.

Theoretical Review
According to Okoli (2019), theories play a crucial role in academic research and journal articles as they are necessary for publication. Similarly, this study utilised three fundamental theories – Resource Based Theory, Institutional Theory, and Human Capital Theory. The study assessed factors affecting the availability performance of the Passengers' Service Vehicles owned by UDART. Again, the study results were the inputs in developing the relevant mathematical maintenance management model and CMMS.

Resource-Based Theory
Ahlemann et al. (2021) suggest that Resource Based Theory (RBT) explains value creation using Information Technology, highlighting the relationship between owned resources and a firm's success. Abdurrahman and Yusuf (2018) suggest that RBT recognizes the value added to assets and examines the earned value of organisational functions. Freeman et al. (2021) link RBT with sustainability, emphasising sustainable competitiveness and people as facilitators for organisational functions.

Institutional Theory
Berthod (2018) states that Institutional Theory is the basis for organisational designs and conducts. The theory indicates that all organisations are interrelated and depend on one another. Fulfilling customary needs validates organisations. Similarly, the theory requires UDART to reduce the service gap by improving the availability performance of the buses. Hence, the success of UDART reflects similarly on the sustainability of the BRT system.

Human Capital Theory

Hitka et al. (2019) define Human Capital as capabilities possessed by people in making products, giving ideas or serving customers in various market conditions. The abilities are the results of accumulated knowledge, skills and other attributes that help to meet organisational or societal goals. Accordingly, this study focused on UDART's maintenance staff and the theoretical literature reviews to reveal the correlation between Institutional Theory and Human Capital Theory. The empirical literature review reveals that previous research focused on analysing the strengths and weaknesses of passenger-serving organisations due to poor automobile maintenance management. However, the results have not clarified how maintenance management can improve the availability of public service vehicles owned by UDART in Dar es Salaam, Tanzania.

Productive Bus Rapid Transit Service Delivery

Chansky and Modica (2018) declared that public transport services improve urban economic conditions by creating job opportunities. UDART should focus on increasing productivity and offering cost-effective BRT services. Proper maintenance and management of passenger service vehicles are crucial for their performance and safety. UDART significantly improves bus maintenance practices to encourage socio-economic development in Dar es Salaam.

Maintenance Management Plans for Bus Rapid Transit Service Delivery

According to Shen et al. (2020), passenger services, including trips and safaris, require proper management and maintenance to ensure productivity and reduce costs. In addition, poor maintenance practices can lead to unscheduled downtimes, environmental pollution, and congested road traffic systems, Hussain et al. (2020). Thus, good maintenance practices optimise fuel consumption and exhaust gas emissions, reducing harmful by-products like evaporative emissions and exhaust gases, Odogun and Georgakis (2019). Again, improving maintenance effectiveness can lower engine maintenance costs and improve safety for passengers and baggage. Therefore, CMMS implementation can help address these issues (Daily & Peterson, 2017).

Maintenance Management Strategies for Productive UDART Services

Ma et al. (2017) define commuters as daily transport services providing repetitive travel between specific destinations. Optimising asset utilisation and profit maximisation can enhance productivity and efficiency in commuter services. However, poor maintenance, fuel bills, and taxes can lead to high service costs. Automotive maintenance management can improve commuter bus service delivery in Dar es Salaam.

According to Walsh (2017), buses facilitate people's movements in urban and rural areas, and IoT technology can efficiently manage bus services. Further, proper maintenance schemes for bus fleets are crucial to avoid challenges like shortages, unscheduled breakdowns, and high maintenance costs, Ambriško and Teplická (2021). Furthermore, Corazza et al. (2018) indicated that early detection of potential vehicle failures can prolong the lives of components and reduce environmental effects. Effective maintenance management can optimise asset utilisation efficiency and achieve a company's productivity, profitability, and effectiveness. Accordingly, Poór et al. (2019) recommended TPM to improve organisations, enhance productivity, decrease unemployment, and maximise profits in the BRT service provision.

Effects of Maintenance Management on Bus Rapid Transit Services Delivery

Public transport services are crucial for passenger transportation, and their quality depends on reliability and accessibility. Preventive maintenance reduces asset breakdowns and enhances asset availability and reliability, extending their life cycles. Maintenance management improves operations performance and market competitiveness, as it reduces costs. Thilakshan and Bandara (2019) recognised transportation as the leading social and economic development sector, and its sustainability depends on service quality and fleet availability performance. Again, Taufik et al. (2021) pointed out that IoT technology can improve planning and management of transport operations, while telematics uses a Global Positioning System and onboard diagnosis to track vehicle movements.

According to Tezel and Aziz (2017), strategic investments, maintenance, and productivity improvement are essential for an organisation's sustainability. Accordingly, maintenance management is the core function of passenger service delivery, ensuring the steady running of organisational functions and continuously improving the productivity and safety of assets. Similarly, this study introduced Automobiles' Computerised Maintenance Management System to improve UDART buses' availability performance.

Maintenance Management Strategies for Productive UDART Services

Ma et al. (2017) define commuters as daily transport services that provide repetitive travel between specific destinations. According to recent studies by Jannah et al. (2020) and Dou et al. (2021), optimising asset utilisation and profit maximisation can enhance productivity and efficiency in commuter services. However, poor maintenance, fuel bills, and taxes can lead to high service costs.

Accordingly, Deveci et al. (2022) revealed that automotive maintenance management can improve commuter bus service delivery in Dar es Salaam. Proper maintenance schemes for bus fleets are crucial to avoid shortages, unscheduled breakdowns, and high maintenance costs. Moreover, Corazza et al. (2018) reminded us of how early detection of potential vehicle failures can prolong the lives of components and reduce environmental effects. Again, a good maintenance management strategy can improve UDART's sustainability by affecting service quality, quantity, and costs.

Maintenance management model for improved availability performance

Nguyen (2016) defines model models as mathematically configured sets providing specific relationships, simplifying scientific knowledge acquisition and enabling critical decisions. Again, they predict outcomes reliably from relevant data sets and effectively predict conditions related to specific data. Furthermore, Breheny and Burchett (2017) stated that regression models isolate outcomes and descriptive variables, while multiple regressions compare descriptions with complex situations.

On the other hand, data sets related to a specific population and relevant values and outcomes should create an excellent prediction model. Thus, a conceptual framework containing eight independent variables, such as maintenance strategies, scheduling, inventory management, quality audit, monitoring, utilisation, safety, human resources management, and availability of tools and equipment, was used to assess the availability performance of UDART buses. The results showed improved quality, increased productivity, profitability, decreased service costs, and growth in passenger service delivery.

Methodical approach

Ragab and Arisha (2018) define research methodology as an analytical approach to solving problems, and Torres-Carrión et al. (2018) explain it systematically. It focuses on specific assumptions that validate research results with the correct choice of research design. According to Sileyew (2019), research design refers to the framework of conditions that govern the collection and analysis of data. Furthermore, it is systematic and economical in structure, aimed at achieving research objectives and accurately answering questions related to the identified problem.

Several categories of research designs include review, correlation, experimental, descriptive, semi-experimental, and meta-analytical designs. Sileyew (2019) mentioned that descriptive-longitudinal case studies are the most commonly known research designs. Notably, each design should align with the relevant research approach.

On the other hand, Kankam (2020) defines an approach as a collection of procedures for conducting a research project, and the data collection approach must suitably accommodate the research population. Again, Thacker (2020) defined a population as a group of entities with specific features or characteristics, such as people, animals, objects, measurements, or buildings. This group provides a study sample and research data. In contrast, Bhardwaj (2019) defined sampling as selecting a specific group of people or objects from a more extensive collection to meet the needs of a research project.

In addition, validating research data is aided by proper sampling, which can be probability or non-probability. Again, Elfil and Negida (2017) define the sampling method as selecting a representative population from an objective population. Baral (2017) stated that research data can be primary or secondary, with primary data gathered to achieve the research goal. Whereas secondary data are collected facts used for new study objectives beyond the original ones, Martins et al. (2018). Conclusively, sampling and data collection are essential components of any research project.

RESEARCH METHODOLOGY

This research study uses a cross-sectional survey design to focus on lengthy bus wait times in Dar es Salaam, Tanzania. The study uses a quantitative approach, focusing on the UDART headquarters in Jangwani. The research involved 360 staff members, including maintenance managers, supervisors, technicians, and operators. The sample size was 78 respondents, with only 71 completing questionnaires.

The study aims to improve bus availability and performance by developing a computerised maintenance management system (CMMS). The study aims to address the issue of passengers waiting over 25 minutes for buses during peak hours, leading to fatigue and increased depreciation rates. The study also aims to develop a computerised maintenance management system to improve bus availability and performance. Again, the sample size computation followed a measured formulation (1).

$$n = \frac{N}{1+N.e^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Again, $$n = \frac{360}{1+360*0.1^2}$$

$$= 78$$

Where:
n = Sample size or number of participants required
N = Research population = 360
e = Standard sampling error (10%) is accepted or tolerated.
Seventy-one participants met the degree of accuracy required for the research after entering values for the respective variables in the calculation.

Table 1: Sample Size Distribution

S/N	Respondents	Population Size	Sample Size	Data Collection Method
1.	Maintenance team	60	13	Structured Questionnaires
2.	Supporting staff	300	65	Structured Questionnaires
Total		**360**	**78**	

This study used primary random selection and purposive sampling to recruit participants from UDART's maintenance staff. Data collection used structured questionnaires and secondary data through UDART statistics. The study used documentary reviews for secondary data collection. The MLR model was used for statistical analysis to determine the correlation between variables. Descriptive statistics and inferential statistics examined the strength of correlations. P values ranging from 0.000 to 0.05 indicated significance levels. The study aimed to standardise or normalise the sample.

$$Yi = \beta_0+\beta_1 X_{i,1} + \beta_2 X_{i,2} + \beta_3 X_{i,3} + \beta_4 X_{i,4} + \beta_5 X_{i,5} + \beta_6 X_{i,6} + \beta_7 X_{i,7} + \beta_8 X_{i,8} + \varepsilon \ldots\ldots 1$$

Where:
Y_i = Dependent variable, availability performance.
X_{i1} =Automobile maintenance plans and strategies
Xi_2 =Automobile maintenance scheduling

Xi_3 =Automobile maintenance inventory management and control
X_{i4}= Automobile maintenance quality, audit and compliance management
X_{i5} =Automobile maintenance monitoring and control
X_{i6} =Automobile utilisation and safety management
X_{i7} = Automobile human resources management
X_{i8} = Availability of automobile maintenance tools, equipment and machines
β_0 = Constant term
β_1 = Coefficient of regression measuring each unit change of a dependent variable as $xi,_1$ changes, that is, changes in availability performance, as automobile maintenance plans and strategies change.
β_2= Coefficient of regression measuring each unit change of a dependent variable as $xi,_2$ changes, that is, changes in availability performance, as automobile maintenance scheduling changes.
β_3 = Coefficient of regression measuring each unit change of a dependent variable as $xi,_3$ changes, that is, changes in availability performance, as automobile maintenance inventory management and control change.
β_4= Coefficient of regression measuring each unit change of a dependent variable as $xi,_4$ changes, that is, changes in availability performance, as automobile maintenance quality, audit and compliance management change.
β_5 = Coefficient of regression measuring each unit change of a dependent variable as $xi,_5$ changes, that is, changes in availability performance, as automobile maintenance monitoring and control change.
β = Coefficient of regression measuring each unit change of a dependent variable as $xi,_6$ changes, that is, changes in availability performance, as automobile utilisation and safety management change.
β_7 = Coefficient of regression measuring each unit change of a dependent variable as $xi,_7$ changes, that is, changes in availability performance, as automobile human resources management changes.
β_8= Coefficient of regression measuring each unit change of a dependent variable as $xi,_8$ changes, that is, changes in availability performance, as availability of automobile maintenance tools, equipment and machines change.
Ɛ = model error term or residuals

RESULTS AND DISCUSSION

The study results analysis used SPSS software, with a coefficient alpha of 0.744, indicating good internal data consistency. The same indicates a commendable accuracy in data collection, linking the study objectives and relevant results and highlighting the study's objectives.

Table2: Reliability Statistics

Cronbach's Alpha	**No. of Items**
0.744	39

Descriptive Analysis

The study analysed data by considering eight variables: maintenance plans and strategies; maintenance schedules; maintenance inventory management and control; maintenance quality, audit, and compliance management; maintenance monitoring and control; automobile utilisation and safety management; human resources management; and availability of tools, equipment, and machines.

Furthermore, some of the independent variables are composites of related study variables. Accordingly, maintenance strategies combine three related independent variables. In particular, the given variable includes the current maintenance strategy, the effects of excessive preventive maintenance, and the effects of poor preventive maintenance on the availability performance of the UDART fleet.

Similarly, maintenance scheduling is a collection of four independent variables. These are maintenance waiting time, delayed condition restorations, and skipped inspections. Again, the given variable includes unscheduled automobile maintenance.

Additionally, maintenance quality, audit, and compliance management combined maintenance financial resources, maintenance costs, maintenance performance, and the quality of the maintenance crew were parts of the study. In addition, monitoring and control comprise the effects of the correct use of workshops, maintenance processes, maintenance policies, and maintenance culture.

The study assessed the factors affecting automobile availability performance at UDART, Dar es Salaam, Tanzania. Similarly, automobile utilisation comprises the effects of overloading, road accidents, and the vehicle's wear. Again, human resources management combines the effects of staff shortages, skilled labourers, and a maintenance management crew. However, data analysis used descriptive statistics.

Effects of independent variables on Buses' availability performance

The study's findings exposed assorted responses from its respondents. Besides, respondents' opinions exposed several factual information. Consequently, Table 4.16 analyses the effects of the relevant independent study variables on UDART buses' availability performance. The responses had a mean of 2.2958 and a standard deviation of 0.48321. Correspondingly, it is evident that maintenance strategies moderately affect the availability performance of UDART buses. Further, the effect of the maintenance schedule is moderate, as indicated by the mean of 2.3204 and standard deviation of 0.90651. Furthermore, inventory management and control affect the fleet moderately, as indicated by the mean of 2.7606 and standard deviation of 1.10149.

On the other hand, maintenance quality, auditing, and compliance management affect buses' availability performance. This remark is evident by a static mean of 3.4613 and a standard deviation of 0.60893. Additionally, the availability performance of UDART buses is highly dependent on automobile maintenance monitoring and control, as indicated by the mean of 3.1761 and standard deviation of 0.52765. Furthermore, the observation indicated that the availability performance of the UDART fleet is highly affected by the usage and safety management of the buses. Respectively, this observation is evident by the static mean of 3.0422 and the standard deviation of 0.91186.

Again, the study observed that human resources management highly affects buses' availability performance. This observation presents a mean of 3.0845 and a standard deviation of 0.79276. Also, maintenance tools, equipment, and machines contribute moderately to the buses' availability. This effect has a mean score of 2.8685 and a standard deviation of 0.36134.

Mathematical Model and CMMS Development

This study uses a multiple linear regression model to analyse the effects of automobile CMMs on the availability performance of UDART buses' fleets. The model examines the relationships between dependent and independent variables, including maintenance strategies, maintenance scheduling, inventory management, maintenance quality audit and compliance management, monitoring and control, and availability of maintenance tools, equipment and machines.

Table 3: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	Statistical Change		
							df1	df2	Sig. F Change
1	.974[a]	.950	.943	.10595	.950	145.820	8	62	.000

a. Predictors: (Constant) availability of tools and equipment; maintenance inventory management and control; human resources management; maintenance strategies, maintenance scheduling; automobile utilisation and safety management; maintenance quality audit and compliance management; monitoring and control.

Table 3 is an output of a linear regression test done with the aid of SPSS. Again, the same represents the model summary of the relevant test. Furthermore, it describes the model characteristics. In addition, the assessment involved eight independent variables: availability of tools, machines and equipment; maintenance inventory management and control; human resources management; maintenance strategies; maintenance schedules; automobile utilisation and safety management; maintenance quality audit and compliance management; and monitoring and control.

R is the coefficient of correlation between independent and dependent variables. Again, the reference relies on the fact that values greater than 0.4 requires further or secondary data analysis. In particular, relationships between relevant study variables are evident by the coefficient of .974. Accordingly, this value indicates a good correlation.

R^2 is the coefficient of determination presenting a total variation on the dependent variable as the independent variables have explained them. Values greater than 0.5 indicate that the given model determines a particular relationship effectively. Accordingly, the determination among the variables holds a coefficient of .950, which is good.

Adjusted R^2 indicates the general result: the deviation of sample results from the population accommodated in the particular multiple regression. Notably, there should be a difference between R^2 and Adjusted R^2. In this case, the value of adjusted R^2 is 0.943

Significance value (P-value or Sign value):
The assessment relied on a 95% confidence or 5% significance level. In that regard, p-values must always be less than 0.05. *Table 3* indicates the relevant significance level as .000. Accordingly, the results are statistically significant.

F-ratio:
Considerably, the F ratio signifies enhancement in the predictor variable. The same is evident in a model fit relative to its inaccuracies. The F-ratio greater than 1 signifies an efficient model. Similarly, *Table 3* indicates that; the F value is 145.820, which is good.

Testing for a 5% significance level or 95% confidence level was done using the study variables. Once more, P would have a P <0.000-0.05 based on the significance value (P value) in the ANOVA and regression coefficient. As a result, the pertinent test used the SPSS program, and the outcomes are in ANOVA *Table 4.*

The results show that the regression model is statistically significant in affecting the dependent variable. The reason is the probability value 0.000, which is less than the 0.05 significance level. The eight independent variables were unique and statistically significant in affecting the availability performance of UDART buses in Dar es Salaam, Tanzania.

Table 4: ANOVA

ANOVA[a]

Model 1		Sum of Squares	df	Mean Squares	F	Sig.
	Regression	13.095	8	1.637	145.820	.000[b]
	Residual	0.696	62	0.011		
	Total	**13.791**	**70**			

a. Dependent Variable: Availability Performance
b. Predictors: (Constant), Availability of tools, machines and equipment, Inventory management, Human resources management, Maintenance strategies, Maintenance scheduling, Automobile utilisation and safety, Maintenance quality audit, control and compliance, Maintenance monitoring and control

Regression Coefficients

Table 5. Regression Coefficients [a]

		Unstandardized Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta(β)	t	Sig.
1	(Constant)	.818	.125		1.353	.002
	Strategies	.11	.004	.138	1.416	.001
	Scheduling	.08	.017	.124	3.126	.002
	Inventory mgt.	.058	.024	.124	4.104	.000
	Quality control	-.086	.136	-.123	-2.196	.003
	Monitoring	-.01	.024	-.125	-2.195	.001
	Utilisation	.021	.025	.109	3.077	.003
	HR Management	.01	.023	.124	3.435	.000
	Tools, equipment	.089	.139	.703	6.233	.000

a. Independent Variables
b. Dependent Variable: Availability Performance

Table 5 shows that strategies (β=0.110, $P<0.001$); scheduling (β=0.08, $P<0.002$); inventory management (β=0.058, $P<0.000$); quality control (β= -0.086, $P<0.003$); monitoring and control (β= -0.1, $P<0.001$); utilisation (β=0.021, $P<0.003$); human resources management (β=0.01, $P<0.000$); and tools, equipment and machines (β=0.089, $P<0.000$ had significant relationships with availability performance. Since all P values were lower than the alpha value (α), 0.05, they were all approved.

Additionally, by controlling other variables, it was found that the availability performance of UDART buses was positively statistically and significantly affected by maintenance strategies, maintenance scheduling, inventory management, automobile utilisation and safety, human resources management, and the availability of tools, equipment, and machines. Likewise, the same correlated negatively with maintenance quality control and maintenance monitoring. Thus, the results suggest that the UDART fleet's availability performance depends on using the invested resources properly.
The study's findings also share similarities with those of Soltanali et al. (2020). Once more, the study showed that scheduled maintenance greatly enhances vehicle performance. Additionally, effective maintenance management always produces deemed achievements.

Multiple Linear Regressions Model Development
The study has considered eight factors or variables that affect availability performance. Accordingly, the relevant coefficients indicate their effects. Again, studied variables or factors, with the effect of their coefficients, collectively bring the relevant availability performance. The multiple linear regression equation 2 presents the overall availability performance of the UDART fleet:

$$AP(T)=\beta0+\beta1AP(MS)+\beta2AP(SH)+\beta3AP(IM)+\beta4XAP(MQ)+\beta5AP(MC)+\beta6AP(UT)+\beta7P(HR)+\beta8P(TE)+ \mathcal{E} \ldots .2$$

Accordingly, the following definitions apply to the availability performance model structured into equation 2:

AP (T) = Total Availability Performance, the dependent variable.

$\beta 0$ = Constant term
$\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, $\beta 5$, $\beta 6$, $\beta 7$ and $\beta 8$ = Coefficients of the dependent or predictor variables
AP (MS) = Factor related to automobile maintenance strategies
AP (SH) = Factor related to automobile maintenance scheduling
AP (IM) = Factor related to automobile maintenance inventory management and control
AP (MQ) = Factor related to maintenance quality audit and compliance management
AP (MC) = Factor related to automobile maintenance monitoring and control
AP (UT) = Factor related to automobile utilisation and safety management
AP (HR) = Factor related to automobile maintenance human resources management
AP (TE) = Factor related to automobile maintenance tools, equipment and machines
Ɛ= Error term or residuals for Availability Performance model

Evidently, after adding relevant coefficients, the model is represented as:
AP(T)=0.817+0.11APMS+0.08APSH+0.058APIM-0.086APMQ-0.1APMC
+0.021APUT+0.01APHR+0.089APTE…………………………………..……………………………………3

Model Validation
The failure rate of the UDART's buses is between 30 to 50 buses daily. Thus, the average breakdown rate is 45 buses. The computation of the relevant availability uses equation 4:

$$\text{Availability} = \frac{Uptime}{Uptime + Downtime} = \frac{Uptime}{Total\ time} \quad \text{(Hirwani and Chaturvedani, 2015)}$$

$$= \frac{Number\ of\ available\ buses}{Total\ number\ of\ buses} = \frac{Total\ number\ of\ buses - broken\ down\ buses}{Total\ number\ of\ broken\ down\ buses} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

$$= \frac{240-40}{240}$$

$$= 84\%$$

The UDART fleet's availability performance is lower than predicted by the mathematical model, indicating the need for a CMMS to improve it. Validation and projected performance data from June 2023 to May 2024 tested the model's validity. The results showed high accuracy and a precision of 99.99%. Effective maintenance strategies, schedule management, quality control, monitoring, inventory management, bus utilisation, human resources management, and availability of tools and equipment are perfect predictors of UDART fleet availability performance.

Discussion
The study findings were consistent with other research on maintenance performance, such as Darestani et al. (2020) and Ingemarsdotter et al. (2021). These studies highlight the benefits of condition-based maintenance in extending the useful life of assets, reducing expenses, and improving productivity.

The study suggests that UDART should manage its resources effectively to achieve its goals, aligning with the Resource-Based Theory. It recommends implementing internal maintenance and transportation policies to maintain buses' availability performance. The study identified eight factors affecting fleet availability, forming the basis for a mathematical model that helps plan and manage vehicle maintenance tasks. The model was used to establish a web-based CMMS for improving UDART buses' availability performance.

Summary of Results
The study collected responses from participants regarding specific variables, which resulted in varied opinions. The study aimed to achieve three objectives. The same are: assess factors affecting the availability performance of public service vehicles owned by UDART, develop a mathematical model to improve availability performance and create a computerised maintenance management system.

Additionally, the predictor variables positively affected the availability of UDART's fleet. However, the correlation between the dependent and independent variables is 97.4%. Again, the predictor variables accounted for 95% of the UDART's availability performance, with 5% as the influence of other variables.

Conclusion and Recommendations

Conclusion

The study aimed to improve the availability performance of UDART's passenger service vehicles by developing a Computerised Maintenance Management System (CMMS). The study achieved its three objectives: analysing factors affecting vehicle availability, developing a mathematical maintenance model, and developing a CMMS. The first objective involved analysing eight factors affecting vehicle availability: maintenance strategies, scheduling, inventory management, quality audit, monitoring, and safety. The second objective was to develop a mathematical maintenance model, which improved availability from 84 to 90.32%. The third objective was to develop a CMMS using a mathematical model and computer-based programming, which passed a test and showed promising results.

Recommendations

The study emphasises the importance of maintenance strategies, scheduling, inventory, quality audits, compliance, bus utilisation, human resources management, and tool availability. It suggests using a CMMS for skill improvement, regular consultation with management, and focusing on applicable policies. The study further recommends that the UDART management enhance fleet operations, invest in modern tools, improve maintenance schedules, implement better strategies, improve inventory management, enhance maintenance quality, audit, and compliance management, enhance monitoring efforts, optimise bus utilisation, and improve human resource management to achieve projected fleet availability performance.

Areas for Further Studies

This study targeted developing automobiles' computerised maintenance management system to improve the availability performance of the buses in the case of UDART Headquarters, Jangwani Depot-Dar es Salaam. In addition, the study is meaningful to other aspects, such as how maintenance management can improve organisational productivity. Again, the study could assess maintenance management's effects on service quality and customer satisfaction.

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