

Final Project 2

PMG 497

The effect of Fleet Maintenance Management on project performance

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The effect of Fleet Maintenance Management on project performance:

A case study in school bus transportation

In SEITCO Company in Madinah/Saudi Arabia

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DEDICATION

This research is dedicated to my family, parents and colleagues.

ABSTRACT

Objective: This research aimed to study the impact of vehicle maintenance on project performance in the Kingdom of Saudi Arabia, the case of Madinah city. The specific research objectives were to know the effects of preventive maintenance on project performance in Madinah, Saudi Arabia, investigate the effects of corrective maintenance on project performance in Madinah, Saudi Arabia and determine the effects of condition-based maintenance on project performance in Madinah, Saudi Arabia. The adopted theories were human capital theory, technology diffusion theory and resource theory.

Methodology: The research used a cross-sectional survey research design. Data were collected using structured questionnaires from a sample of 150 respondents, through simple and purposive random sampling techniques. The collected data were calculated in SPSS 28 data sheet, to generate statistical measures to present the results.

Thus, the relationships between the research variables were tested using descriptive and inferential statistics; including frequencies, percentages, correlation and multiple regression analysis of ordinary least squares.

Results: The research results indicated that effective corrective maintenance and preventive maintenance significantly enhance the project in the Kingdom of Saudi Arabia, as they established positive and significant relationships between them and project performance.

The relationships were statistically significant at the 5% significance level. Therefore, improving corrective maintenance and preventive maintenance also improves project performance by 51.8% and 26.7%, respectively.

Scientific addition: The importance of preventive maintenance and corrective maintenance significantly affects project performance.

Therefore, it is recommended to pay proper attention to these maintenance strategies, as they significantly affect project performance in Saudi Arabia.

Practical applications: This can be achieved by using appropriate policies and procedures in vehicle maintenance and related management roles such as hiring skilled personnel; allocating sufficient budgets and regular training for relevant human resources. The repair and maintenance garage must complete the service and maintenance of vehicles and equipment on time, and avoid re-maintenance work through quality inspection and verification to avoid recurring technical failures after service and maintenance. Likewise, the organization must implement a driver/operator behavior management and communication system to facilitate coordination and integration between work tasks, and development and learning programs in the organization to achieve the goal of the driver training and management system.

Keywords: Fleet management, repair and maintenance management, fuel management, vehicle tracking management, driver training and management, vehicle disposal and replacement management, Project Performance.

الملخص

الهدف: هدف هذا البحث إلى دراسة تأثير صيانة المركبات على أداء المشاريع في المملكة العربية السعودية، حالة مدينة المدينة المنورة. وكانت أهداف البحث المحددة هي معرفة آثار الصيانة الوقائية على أداء المشاريع في المدينة المنورة، المملكة العربية السعودية، والتحقيق في آثار الصيانة التصحيحية على أداء المشاريع في المدينة المنورة، المملكة العربية السعودية وتحديد آثار الصيانة القائمة على الحالة على أداء المشاريع في المدينة المنورة، المملكة العربية السعودية. وكانت النظريات المعتمدة هي نظرية رأس المال البشري ونظرية انتشار التكنولوجيا ونظرية الموارد.

المنهجية: استخدم البحث تصميم بحث مسح مقطعي. تم جمع البيانات باستخدام استبيانات منظمة من عينة من 150 مستجيبًا، من خلال تقنيات أخذ العينات العشوائية البسيطة والهادفة. تم حساب البيانات التي تم جمعها في ورقة بيانات SPSS 28، لتوليد مقاييس إحصائية لعرض النتائج. وبالتالي، تم اختبار العلاقات بين متغيرات البحث باستخدام الإحصاءات الوصفية والاستدلالية؛ بما في ذلك الترددات والنسب المئوية والارتباط وتحليل الانحدار المتعدد للمربعات الصغرى العادية. **النتائج:** أشارت نتائج البحث إلى أن الصيانة التصحيحية والصيانة الوقائية الفعالة تعززان بشكل كبير من أداء المشروع في المملكة العربية السعودية، حيث أقامت علاقات إيجابية ومهمة بينهما وبين أداء المشروع.

وكانت العلاقات ذات دلالة إحصائية عند مستوى الدلالة 5%. وبالتالي فإن تحسين الصيانة التصحيحية والصيانة الوقائية يحسن أيضًا من أداء المشروع بنسبة 51.8% و 26.7% على التوالي.

الإضافة العلمية: إن أهمية الصيانة الوقائية والصيانة التصحيحية تؤثر بشكل كبير على أداء المشروع، لذلك يوصى بالاهتمام المناسب بهذه الاستراتيجيات الصيانة، حيث أنها تؤثر بشكل كبير على أداء المشروع في المملكة العربية السعودية.

التطبيقات العملية: يمكن تحقيق ذلك من خلال استخدام السياسات والإجراءات المناسبة في صيانة المركبات والأدوار الإدارية ذات الصلة مثل توظيف الموظفين المهرة؛ وتخصيص الميزانيات الكافية والتدريب المنتظم للموارد البشرية ذات الصلة. ويجب على ورشة الإصلاح والصيانة إكمال خدمة وصيانة المركبات والمعدات في الوقت المحدد، وتجنب أعمال إعادة الصيانة من خلال فحص الجودة والتحقق لتجنب الأعطال الفنية المتكررة بعد الخدمة والصيانة. كما يجب على المنظمة تنفيذ نظام إدارة وتواصل سلوك السائق/المشغل لتسهيل التنسيق والتكامل بين مهام العمل، وبرامج التطوير والتعلم في المنظمة لتحقيق هدف نظام تدريب وإدارة السائقين.

الكلمات المفتاحية: إدارة الأسطول، إدارة الإصلاح والصيانة، إدارة الوقود، إدارة تتبع المركبات، تدريب وإدارة السائقين، إدارة التخلص من المركبات واستبدالها، أداء المشروع.

Table of Contents

ACKNOWLEDGEMENT	3
DEDICATION	4
ABSTRACT	5
LIST OF FIGURES	11
LIST OF TABLES	11
1.1 INTRODUCTION:.....	12
1.2 Research Problem:	16
1.2.1 Theoretical Gap:	16
1.2.2 Empirical Gap:	16
1.3 Significance of Research:	17
1.3.1 Research Questions:	17
1.3.2 Questions-Sub Research:.....	18
1.4 Research Objectives:	18
1.5 Research Hypotheses:.....	19
1.6 Research Model:	20
1.7 Empirical Study:	21
1.8 Suggested Project Structure:	21
1.9 Conclusion	22
Chapter Two: literature review	23
2.1 Introduction.....	23
2.2 Evolution of Maintenance Policies	24
2.3 Fleet management.....	25
2.3.1 Vehicle Maintenance	27
2.3.2 Importance of Vehicles Maintenance in Fleets Operations	27
2.4 Theoretical Review	28
2.4.1 Human Capital Theory.....	28
2.4.2 Resources Based Theory.....	29
2.5 Fleets Operations Management	30
2.6 Preventive Maintenance	31
2.7 Corrective Maintenance	33
2.8 Condition Based Maintenance	34
2.9 Project Performance.....	35
2.9.1 Project performance measures.....	36
2.9.2 Project management practices	36
2.10 Relationship between Fleet maintenance management & Project performance	37

2.11 Conclusion	41
Chapter Three: Research Methodology	42
3.1 Introduction:	42
3.2 Operational definitions for research variables:	42
3.2.1 Fleet Maintenance Management (The independent variable)	42
3.2.2 Project performance (The dependent variable)	42
3.3 Research Design:	43
3.4. Research population & Sampling methods and technique:	44
3.4.1 Population Research:	44
3.4.2 Sample Research:	44
3.4.3 Techniques & Method Sampling:	45
3.5 Data collection method	45
3.5.1 Primary data	47
3.5.2 Secondary data	47
3.5.3 Data analysis methods	47
Chapter Four: Statistical analysis of the study results	49
4.1 Introduction	49
4.2 Characteristics of the study sample	50
4.3 Measuring the validity and reliability of the study tools	56
4.3.1 Validity of the scales used in the study	56
4.3.2 Stability of the study tool	60
4.4 Descriptive analysis of study variables	61
4.5 Correlation coefficients between study variables	65
4.6 Study Hypothesis Test Results	67
4.7 Conclusion	78
Chapter Five: conclusion and recommendations	79
5.1 Introduction	79
5.2 Research Limitations & Future Research	79
5.3 Recommendations	80
5.4 Summary of Findings	82
5.5 Conclusion	83
6. Reference	84
7. Appendices	89

LIST OF FIGURES

Figure 1: Suggested research model: Source Student.....	20
Figure 2: Research Onion.....	43
Figure 3: Sample classification according to gender.....	51
Figure 4: Classification of the study sample according to age.....	52
Figure 5: Sample classification according to educational level.....	53
Figure 6: Classification sample according to the level of experience.....	54
Figure 7: Classification sample according to the nature of work.....	55

LIST OF TABLES

Table 1: Source Student: Based on the website (Google Form).....	44
Table 2: Source: Student: Targeted employees.....	44
Table 3: Source: Student: Degree of approval.....	45
Table 4: Source: Student: Fleet Management (The independent variable).....	46
Table 5: Source: Student: Project performance (The dependent variable).....	47
Table 6: Component Factor Analysis.....	57
Table 7: Exploratory Factor Analysis.....	59
Table 8: Measurement of reliability of study tools.....	60

1.1 INTRODUCTION:

Performances in terms of productivity and efficiency. Companies, then, buy the maintenance service from external maintenance firms to reduce their maintenance costs, to close maintenance capacity gaps, and to lower maintenance management complexity. (EDWIN, B., 2022).

Companies with own road vehicle fleets attain profit by performing transport services. The amount of profit is significantly influenced among other things, by the costs incurred by transport and vehicle maintenance processes. Considered companies seek to accomplish all the planned transport tasks while minimizing transport and maintenance costs. (Vujanović et.al. 2012). Maintenance is commonly described as an activity intended to restore or keep an asset in a state in which it can perform its functions. In other words, maintenance can be portrayed as the set of actions carried out on an asset in order to ensure that the asset continues to perform its intended functions by repairing any equipment that has failed and/or by restoring it to its favorable operating condition. (Vujanović et.al. 2012).

Therefore, maintenance is aimed at reducing, in quantity and length, production process interruptions. This implies that the maintenance activity should increase the reliability of production assets by decreasing their failures. However, the objective of failure reduction does not probably yield the best results with regard to the financial objectives, because the costs of higher assets reliability may exceed the returns deriving from the consequent improvement of the production performance. As all company sub-systems, also maintenance has to be intended to increase company profits. (Vujanović et.al, 2012).

Consequently, maintenance management should carefully evaluate costs and benefits deriving from the different maintenance policies. With this regard, Wireman⁵ defines maintenance management as "the management of all assets owned by a company, based on maximizing the return on investment in the asset". The main objective of maintenance management, (Bivona, & Montemaggiore.,2005). Maintenance and management practices must adopt proper strategies in day-to-day operations.

State that, most of previous researches have been examining considerably issues related to transport and fleet management. (EDWIN, B., 2022).

However, most of them explored effects of fleet management on disasters and relief responses, and general humanitarian. (EDWIN, B., 2022).

Basing on the National plans and policies, proper vehicles maintenance shall improve transport operations and services at lower costs, in-line with socio-economic development. (EDWIN, B., 2022).

This will make growth of the sector sustainable without adverse environmental effects. The focus should also be made on setting appropriate policies for guiding maintenance planning and management functions. In addition, number of vehicles being grounded due to poor maintenances shall be reduced. More than so, overall vehicles' running costs shall be cut to a minimum level. (EDWIN, B., 2022) However, maintenance outsourcing presents some side effects.

First of all, maintenance contractors lack a long-term view that embraces the entire life span of the assets. Consequently, they tend to ignore maintenance activities addressed to improve the working conditions of company's assets. . (EDWIN, B., 2022) Furthermore, maintenance outsourcing may imply an impoverishment of the company know-how. . (EDWIN, B., 2022).

By contracting out the maintenance of equipment's with high level of know-how, companies tend to invest less in maintainers training, reducing, in the longer term, their skills. . (EDWIN, B., 2022) In this sense, for an efficient fleet maintenance management it is necessary to observe jointly: (1) the transport process as a primary (core) process that brings profit to the company; (2) the vehicle maintenance, as logistical support to the core transport process, which by means of maintenance interventions transforms vehicle condition from the state of “unready for operation” to the state “ready for operation”; (3) the environment, associated to safety and environmental protection from the maintenance impact, which is monitored via technical inspections. For an integrated approach to maintenance management an important concept is the “Process based maintenance” (Zhu, et.al, 2002) and (Zhu & Pintelon, 2001).

This concept, among other things, involves the definition of necessary indicators, which allow measuring the implementation effects of specific measures during. (Vujanović et.al., 2012).maintenance management, monitoring the value of indicators in relation to the adopted thresholds and management decision making in the event of unauthorized indicator values deviation from threshold values.(Vujanović et.al., 2012).

The proposed model can be used to evaluate the managers’ perception of the importance of maintenance management to increase the fleet energy efficiency. (Vujanović et.al, 2012).

The prospective model will help the firms to operate their fleets more strategically, coordinate effectively utilization of vehicles and human resources, thus attaining optimum efficiency and performance of fleets operations. (EDWIN, B., 2022).

Again, proper execution of maintenance increases significantly vehicles’ availability, durability and reliability. (EDWIN, B., 2022).

Therefore, fleet maintenance has a significant role in keeping-up organizational performance, particularly road transportation functions. Evidently, body of knowledge on fleets maintenance and management has enough literatures on. But still it doesn't cover substantially the contribution of vehicles maintenance in facilitating regular organizational activities. (EDWIN, B., 2022).

However, in the last decades, maintenance strategies have been evolving aiming "to carry out as little maintenance as possible [and] as infrequently as possible while at the same time preserving the availability "of company assets. For this reason, managers have been forced to adopt maintenance planning and control systems to revise their policies more accurately. In particular, the aim of these tools is to support managers in identifying the most convenient maintenance policies in accordance with the breakdown patterns of the different assets. (Bivona & Montemaggiore. 2005).

The importance of the relationships between asset e maintenance management has been widely recognized both in literature and in practice. Maintenance costs represent a relevant percentage of the total costs a company has to bear for the entire life of an asset. As a consequence, purchasing decisions based only on acquisition costs may reduce expenses in the short term but repercussions may be experienced later in the form of increased breakdowns and unavailability. For this reason, the concept of Life Cycle Cost (LCC) was developed. Conceived in the sixties, life cycle costing is a technique for the analysis of the total costs a company forecasts to sustain for the acquisition, operation, maintenance, and disposal of an asset over its expected useful life span. (Bivona & Montemaggiore. 2005). The life cycle concept "helps managers to understand acquisition costs vs. operating and support costs, i.e. to find a correct balance between investment costs vs. operating expenses"²¹. In particular, LCC creates "awareness among the managers to produce an effective system with not

only a low acquisition cost but also low operation, support and disposal costs. (Bivona & Montemaggiore. 2005).

1.2 Research Problem:

The case study intended to assess effects of vehicles' maintenance on the performance of fleets operation in Madina. Specifically, choice of case study area is due to considerable growth of fleets operations and relevant maintenances within the City.

1.2.1 Theoretical Gap:

Primarily, most of reviewed documents centered on creating awareness on fleet management practices, for large profit making organizations in particular. Each of them contributed much in adding knowledge in that area. However, those case studies did not cover information, which expounded comprehensively how preventive maintenance, corrective maintenance and condition-based maintenance can optimize.

1.2.2 Empirical Gap:

Basing on reviewed empirical studies, many case study have been conducted outside the country on vehicles maintenance and fleet management Also Ally (2020) assessed regulation and policies governing fleet management systems, to comply with public fleet management.

This is a significant contribution in a knowledge base related to maintenance and management of allied operations However; literatures do not contain knowledge on the specifics of stipulated research topic and area.

In this regard, this case study examined effects of vehicles maintenance on the project performance of fleet operation.

1.3 Significance of Research:

Results are based on the facts and opportunities derived from the data collected. The case study outcomes will benefit stakeholders of transport business by providing information, to facilitate relevant operations.

For public institutions, case study results hold useful information to fleets' managers. It shall guide on how to make decisions correctly, by referring to presented results, for the good of their organizations.

This will improve vehicles' maintenance practices in respect with relevant fleets' management plans and project performance, qualitatively and quantitatively.

Basing on the National plans and policies, proper vehicles maintenance shall improve transport operations and services at lower costs, in-line with socio-economic development.

This will make growth of the sector sustainable without adverse environmental effects. The focus should also be made on setting appropriate policies for guiding maintenance planning and management functions. In addition, number of vehicles being grounded due to poor maintenances shall be reduced. More than so, overall vehicles' running costs shall be cut to a minimum level.

1.3.1 Research Questions:

To attain above specific objectives, this work was guided by the following research questions.

1. What are the effects of maintenance on the project performance of fleet operations management?
2. How does effective communication impact project performance?

1.3.2 Questions-Sub Research:

Sub-Question 1: What is the impact of preventive maintenance on the project performance of fleet operations management?

Sub-Question 2: What is the impact of Fuel Management System on the project performance of fleet operations management?

Sub-Question 3: What are the factors affecting project productivity and their implications for project performance?

Sub-Question 4: How does fleet maintenance to project performance improvement?

Sub-Question 1: What are the communication channels used in project teams?

Sub-Question 2: How does team cohesion impact project productivity?

Sub-Question 3: What strategies can enhance stakeholder communication in project performance?

1.4 Research Objectives:

Research objective: To investigate the impact of maintenance on project performance in fleet operations management.

Research objective: To investigate the impact of preventive maintenance on project performance in fleet operations management.

Research objective: To investigate the Vehicle replacement and Disposal Management on project performance in fleet operations management

Research objective: To evaluate the factors affecting project productivity and their implications for project performance.

Research Objective: To investigate the relationship between team dynamics and project team performance.

Research Objective: To examine the impact of stakeholder engagement on project.

Research Objective: To assess the effectiveness of agile project management methodologies in improving project efficiency.

1.5 Research Hypotheses:

There is statistically significant relationship between fleet maintenance management and project performance.

There is statistically significant positive relationship between preventive maintenance and project performance in fleet operations management.

There is statistically significant positive relationship between risk management strategies (condition-based maintenance) and project performance in fleet operations management.

There is statistically significant relationship between team communication and project success.

There is statistically significant positive relationship between stakeholder engagement and project quality.

There is statistically significant negative relationship between project delays and stakeholder satisfaction.

1.6 Research Model:

The following figure shows the relationship between the study variables and the study hypotheses as follows:

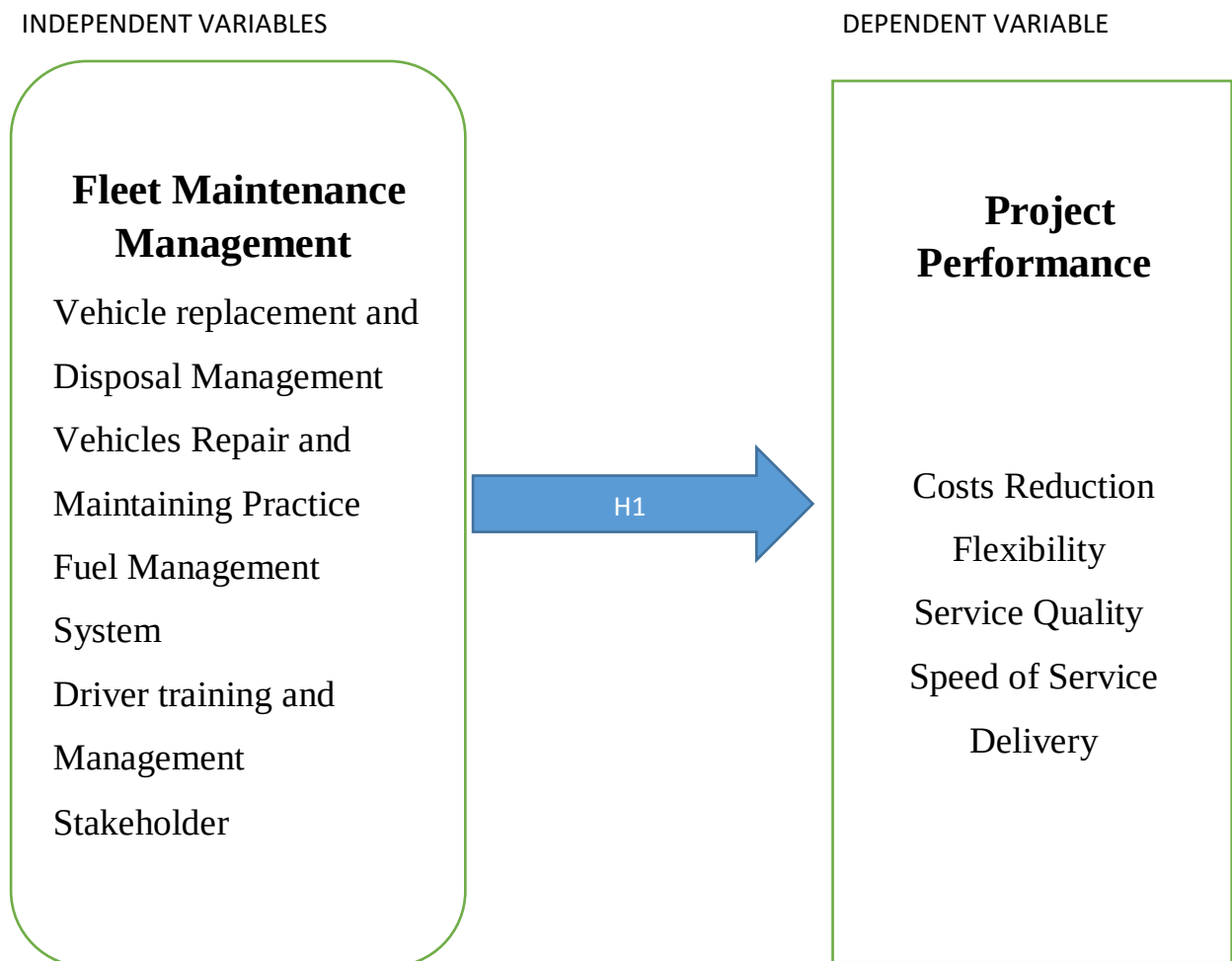


Figure 1. Suggested research model: Source Student

1.7 Empirical Study:

In the year 2014 AD, the company was established between “SAPTCO” and “Emirates Transport” for the purpose of providing safe and reliable transportation services in the office airport sector, as a result of which “SETCO” was designed the Saudi-Emirati Integrated Transport Company (SITCO) is one of the largest educational transport companies in the region, serves more than 500 schools around the Kingdom, and contributes to transporting more than 200,000 students daily.

SITCO's commitment to teaching covers three main regions in the Kingdom of Saudi Arabia, namely Riyadh, the general city, Madinah and Tabuk, with an area of more than 700 thousand km².

Existing studies on project performance improvement mainly investigate project management (PM) execution processes. Limited publications investigate the project management office's (PMO) proficiency in facilitating proper PM practice. This paper identifies the key performance indicators (KPI) of PMO operations and develops a KPI-based performance management system (KPMS) for revitalizing PMO performance for an engineering-service contractor (ESC).

1.8 Suggested Project Structure:

Chapter 1: Introduction •

Chapter 2: Literature Review •

Chapter 3: Research Methodology •

Chapter 4: Statistical Analysis •

Chapter 5: Findings` Discussion and Conclusion•

1.9 Conclusion

Maintenance protects vehicles from unplanned downtimes and damages resulted from road accidents due to mechanical, electrical and electronic failures. In addition, poorly maintained vehicles' disrupt activities within organizations. Therefore, this research intended to examine effects of proper vehicles maintenance on the performance of operations related to particular organizations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In order to attain an efficient maintenance management, it is necessary to coordinate the primary (core) process with maintenance, which has been researched mostly in the field of industrial production (Ashayeri et al., 1996, Brandolese et al., 1996, Nikolopoulos et al., 2003, Waeyenbergh and Pintelon, 2002). In these papers different models and systems have been proposed, all with the objective of increasing efficiency and productivity of industrial machines.

However, vehicle operation and maintenance processes differ from those related to industrial machines. The fact that vehicles are mobile assets, further affected by a large number of external environmental factors imposes the need for a different approach in their maintenance management, compared to other static machines.

In this sense, for an efficient fleet maintenance management it is necessary to observe jointly: (1) the transport process as a primary (core) process that brings profit to the company; (2) the vehicle maintenance, as logistical support to the core transport process, which by means of maintenance interventions transforms vehicle condition from the state of “unready for operation” to the state “ready for operation”; (3) the environment, associated to safety and environmental protection from the maintenance impact, which is monitored via technical inspections.

For an integrated approach to maintenance management an important concept is the “Process based maintenance” (Zhu, Gelders, & Pintelon, 2002) and (Zhu & Pintelon, 2001).

The transit operational planning process includes four basic components that are performed in sequence: (1) network route design, (2) setting timetables, (3) scheduling vehicles to trips, and (4) assignment of drivers. It is desirable for all components to be planned simultaneously in order to optimize productivity and efficiency. (Haghani & Shafahi,. 2002).

However, due to the complexity of the problem, transit planning is performed in a sequential manner in which the outcome of one-step is fed as an input to the next step. Fleet maintenance is another major component in bus transit operations and is one of the major problems with which the public transit agencies are faced.(Haghani & Shafahi,. 2002).

2.2 Evolution of Maintenance Policies

Maintenance is commonly described as an activity intended to restore or keep an asset in a state in which it can perform its functions. In other words, maintenance can be portrayed as the set of actions carried out on an asset in order to ensure that the asset continues to perform its intended functions by repairing any equipment that has failed and/or by restoring it to its favorable operating condition. Therefore, maintenance is aimed at reducing, in quantity and length, production process interruptions.

This implies that the maintenance activity should increase the reliability of production assets by decreasing their failures. However, the objective of failure reduction does not probably yield the best results with regard to the financial objectives, because the costs of higher assets reliability may exceed the returns deriving from the consequent improvement of the production performance. As all company sub-systems, also maintenance has to be intended to increase company profits. Consequently, maintenance management should carefully evaluate costs and benefits deriving from the different maintenance policies. (Bivona & Montemaggiore. 2005).

2.3 Fleet management

Transportation is at the center of logistics as it represents the physical movement of materials between points in a supply chain. The problem involve in the transportation industry is fleet management. Fleet management is the broad topic that involve vehicles maintenance, operation capacity, driver selection and so on. (Khalid et al, 2020).

Malekian et al. (2016) defines fleet management as a process of monitoring fleet endeavors to come up with decisions related to available assets, particularly vehicles; their routes, dispatches acquisitions and their disposals. This helps firms to comply with established objectives, optimize efficiency and minimize costs. Furthermore, the term fleet defines any entity such as an individual or organization, having any number of vehicles from five and above. Redmer (2020) defines fleet as a number of motor vehicles owned by a particular organization to meet its transport necessities.

The reliability, safety, and vehicle life in bus transit systems depend on the maintenance system employed by the agencies. Maintenance costs are the second highest expense category after vehicle operations (Bladikas and Papadimitriou, 1986). They account for approximately 21% of the total operating expenses in a typical transit system (Purdy and Wiegmann, 1987). These facts make maintenance one of the most important and substantial elements of transit systems. Considering that maintenance costs have increased 33% faster than vehicle operating costs, and four times faster than general/administrative costs in recent years (Purdy and Wiegmann, 1987), providers of public transportation are being challenged by high costs, dwindling sources of support funds, and pressures to improve services. Therefore, transit agencies make capital investments in

maintenance systems with the objective of having a reliable, safe and attractive transit system.(Haghani & Shafahi,. 2002).

In most bus transit agencies' operations, buses are not assigned a fixed daily service schedule. To meet the daily route service requirements, buses are assigned to a scheduled route service on a daily basis. (Haghani & Shafahi,. 2002).

This is mainly due to parking space limitations in bus depots which force the depot managers to park the buses, one after the other, in long lines that are sometimes as long as 14 or more buses. In such situations, a bus that is parked in the middle of a line cannot move until all the buses that are parked in front of it are moved. (Haghani & Shafahi,. 2002).

Since the buses generally arrive randomly, they are parked in the same order as they arrive in the garage. Therefore, there is no guarantee that the parking pattern is the same every day. Under these circumstances, the buses cannot have a fixed schedule. (Haghani & Shafahi,. 2002).

To meet the daily service schedule, the dispatchers decide which bus must serve a particular line on a daily basis based on the day's parking pattern. In such an operation, scheduling maintenance services is very simple. The entire fleet can be basically viewed as a pool of buses from which buses can be drawn either for daily service or for maintenance. (Haghani & Shafahi,. 2002).

The evolution of fleet maintenance and management policies highlights the growing importance of maintenance issues in both private and public companies. The need to improve maintenance performance requires an accurate evaluation of the trade-off between costs and benefits related to alternative fleet maintenance and management policies. However, the complexity of maintenance system makes this evaluation a very difficult task.

2.3.1 Vehicle Maintenance

Jun et al. (2015) defines vehicle maintenance as a combination of technical and managerial activities carried out to retain the functionality of a vehicle during its life-time. Merriam Webster Dictionary (2019) pointed that, maintenance is a number of actions to retain a property such as a vehicle in its good operating condition through repairs, adjustments or calibrations, replacement of parts, cleaning, etc. Thus, vehicle maintenance restores vehicles in standard working conditions. (Haghani & Shafahi,. 2002).

Werner et al. (2019) state that, maintenance is one of the leading challenge in many industries, automotive being among them. Chowdhury and Fahim (2019) also state, vehicles which are not road worthy are dangerous to road users as they can cause road accidents.

Gul et al. (2019) declare that, regular vehicles maintenance is one of the measures, which can be taken to reduce risks related to road transport hazards. Daily and Peterson (2017) determined that, proper vehicle maintenance increases vehicles' reliability. (Haghani & Shafahi,. 2002).

In this regard, firms should involve proper management and continuous monitoring on vehicles' conditions. Cebe et al. (2018) state that, detailed and accurate vehicle maintenance record or history helps to solve most of its complex problems. Sridhar and Venkateswaran (2021) state that, the alerts and 15 updates on maintenance requirements can reduce downtime and disruption of activities. This can be achieved by using IoT for continuous monitoring of critical systems. (Haghani & Shafahi,. 2002).

2.3.2 Importance of Vehicles Maintenance in Fleets Operations

Satheeskumar (2021) postulated that, running a bus services or trucks company business requires good maintenance strategies, to ensure efficient running of its operations. Again, effective fleet maintenance contributes

much in maximizing profits. Thus vehicles should be regularly monitored to ensure their availability and reliability in serving intended operations. Kunz et al. (2015) states that, poor vehicle fleet management affects transportation operations. It reduces productivity, cause customers' dissatisfaction and bring harmful effects to the environment. (Haghani & Shafahi,. 2002).

Transporters should devote enough efforts to overcome such effects. Evidently, maintenance optimizes fuel consumption and reduces late deliveries of goods, thus it favors profit maximization. (Haghani & Shafahi,. 2002).

2.4 Theoretical Review

Distinctly, three theories have been used to explain issues regarding effects of vehicle maintenance on the performance of fleet's operations. Some of key theories reviewed underpinning vehicle maintenance and fleet performance are; Human Capital Theory, Resource Based Theory and Technology Diffusion Theory. . (Haghani & Shafahi,. 2002).

2.4.1 Human Capital Theory

Hayek et al. (2016) state that, human capital theory is a theoretical context, explaining objectively the success within organizational settings. Again, human capital development brings better pays due to improved work performances. But this is a challenge in most of developing countries. Pasban and Nojedeheh (2016) indicated human capital being vital in upgrading organizational assets, since it improves work performances, as a result of competences of all individuals within organizations. (Haghani & Shafahi,. 2002).

Accordingly, this research examined effects of vehicles' maintenances using the highest qualified and competent personnel on improving fleets operations. In the context of this research, human capital is meant for competent workforces, such as fleet managers, drivers, clerks, technician, etc., working within organizational fleets. In this regard, vehicles maintenances and management should comply with minimum requirements of job performances in hiring relevant personnel. (Haghani & Shafahi,. 2002).

2.4.2 Resources Based Theory

Radjenović and Krstić (2017) state that, level of success of any firm is dependent on the level of performance relative to resources employed. Thus, the higher the workers perform, the higher the success the firm derives. This means, improvement can only be achieved following improvement of possessed resources. Relevant improvements can be made through regular training to staff and use of modern tools or technologies. (Haghani & Shafahi,. 2002).

In the context of this research, Resource-Based Theory is used to indicate relevance between resources and the success of the organization, relative to other external factors. In particular, it ascertains relationship between resources owned by organizations such as vehicles, personnel, technology and funds with the performance in transportation activities. (Haghani & Shafahi,. 2002).

2.5 Fleets Operations Management

Chulze Spüntrup et al. (2022) postulated that, managing transportation activities involves planning, monitoring and controlling transport operations, to attain organizational goals. The process involves fleet management functions, focusing on optimizing effectiveness, mainly minimizing costs. Ahn et al. (2020) identified transportation as a part of overhead costs within organizations. Similarly,

Thomas et al. (2020) state that, fleet management operations include cost management, vehicles maintenances, shifts management and drivers' roisters management. More than that, it involves tracing the use of assets, managing driving behaviors, managing fuel consumption and managing occupational health and safety issues within organizations. (Haghani & Shafahi,. 2002).

In addition, Rane et al. (2020) pointed that, companies undertake fleet management practices to reduce risks linked with invested vehicles. It also helps to optimize fleets' efficiencies and comply with government regulations on vehicles' safety and roadworthiness. Kameme (2019) recognized importance of real-time data on trucks movements in bringing the required changes. (Haghani & Shafahi,. 2002).

Moreover, it was pointed that employees' performance management being a key role in bringing deemed changes. Again, poor leadership badly affects changes. More than that, Ozkeser (2019) mentioned human resources management, recruitment, selection, communication and training as the motives 18 to change. As well, real-time information on trucks' movements, drivers' monitoring, and customers' services improvement and fleet management improvement as the motivations to change. (Haghani & Shafahi,. 2002).

Dembetembe (2017) states that, open-pit operations bring more than 60% of surface based productions. As well, haulage costs generate 60% of entire

operation expenses. This shows how challenging is keeping-up effective resources management systems. Besides, fleet management practice does not contain an approach applicable in solving all fleets' concerns. Bogh et al. (2022) state that, the challenges in fleets' management increase as the intensity of fleets operations or size becomes higher. The main cause for this problem is disorganized nature of optimization issues. (Haghani & Shafahi,. 2002).

This means, modelling can be done to combat relevant challenges statistically, but prediction cannot be done accurately and statistically. . (Haghani & Shafahi,. 2002)

Eswar et al. (2018) states that, as a number of transportation facilities such as buses, trucks and cars increases, fleet management role becomes more challenging. This means, management of assets cannot be efficient and effective. Specifically, the common challenges are on-site operation errors; unscheduled downtime for critical equipment; unfavorable weather conditions and limited budgets for buying equipment. This raises a need to determine specific fleet needs and priorities, to relate designs specifications and the requirements of particular fleets. . (Haghani & Shafahi,. 2002).

2.6 Preventive Maintenance

Er-Ratby and Mabrouki (2018) state that, preventive maintenance reduces possible failures of items. This is performed at the scheduled intervals or as per the recommended conditions or requirements. Xu et al. (2021) state that, preventive maintenance reduces wear and tear rates of vehicles. In addition, it reduces occurrence of major vehicle faults and overall maintenance cost. . (Haghani & Shafahi, 2002).

Regular checkups of vehicles is another necessary part of preventive maintenance, as it helps to take relevant proactive measures, to avoid

consequences that are more serious. Ramakrishnan and Nallusamy (2017) states that, preventive maintenance is the best practice that can greatly reduce or prevent vehicle breakdowns. . (Haghani & Shafahi, 2002).

This is due to the fact, it bases on distance travelled by a vehicle, duration the vehicle operates, engine-working hours, or amount of fuel the vehicle has consumed. Suryadarma and Ai (2020) pointed that, the practice involving inspection, calibrations, adjustments, cleaning, testing, parts replacement, oiling, greasing, repairing to mention by few. Again Basri et al. (2017) state that, preventive maintenance involves operations management perspectives. Management part facilitates the making of decision related to fleets' activities, which are; defining maintenance objectives and approaches needed in solving relevant problems. . (Haghani & Shafahi,. 2002).

Additionally, maintenance operations focus on maintaining vehicles to their standard conditions. . (Haghani & Shafahi,. 2002).

Zvolenský et al. (2021) indicated how preventive maintenance could facilitate availability and reliability of diesel locomotives indexes. (Haghani & Shafahi,. 2002)

The aim was to assess the capacity to which preventive maintenance affect the economic part of the fleet operations, either positively or negatively. The research used Fault Tree Analysis, also Monte Carlo simulation. A sample of 75 diesel locomotives 20 was used to accomplish the process. The results revealed that, the opted approach provided the relevant results when matched with the real vehicles maintenance plans. . (Haghani & Shafahi,. 2002).

Purnamawati and Radam (2019) determined effects of aging on adding to the vehicles' operating costs in the public transport services in Banjar Regency, Indonesia. Data were collected through interviews with the transporters and vehicles' operators' or drivers. This involved both primary

and secondary sources. Data were processed and analyzed by regression method so that to formulate the model. The research revealed a very strong relationship between the vehicles' aging and the relevant costs of operations. The vehicles aged up to 25 years indicated a correlation of 0.901, whereas those of above 25 years of age indicated a correlation of 0.995. These coefficients were meant for the costs of fuel, general maintenance and depreciation. (Haghani & Shafahi,. 2002).

2.7 Corrective Maintenance

Er-Ratby and Mabrouki (2018) state that, corrective maintenance means the repairs performed following the breakdowns, caused by identifiable failures. Sukma et al. (2019) state that, corrective maintenance involves replacing failed components, systems or subsystems, to restore the vehicles to their good operating conditions. In general, the costs of the respective corrections need to be set to minimum possible levels, to reduce the costs for their relevant inventories. (Haghani & Shafahi,. 2002).

Otieno (2016) researched on how corrective maintenance can influence operational performance of the manufacturing companies. Additionally, it aimed to determine the extent to which the companies use corrective maintenance as a part of their strategies.

The collection of data was done through questionnaires, then processed by SPSS and MS excel programs. The results indicated, 23.1 % of the firms use corrective maintenance. (Haghani & Shafahi,. 2002)

Others use preventive maintenance and corrective maintenance policies. (Haghani & Shafahi,. 2002)

In addition, the research revealed the use of planned corrective maintenance. (Haghani & Shafahi,. 2002)

Again, Voicu and Fuiorea (2021) state that, corrective maintenance involves diagnosing, identifying and repairing the faults as determined by relevant symptoms. Corrective maintenance is categorized into; fail to repair, of which a vehicle is restored to a normal operating condition after failing to operate; salvage, disposing removed or unwanted components; rebuild, restoring the components nearly to designed states.

Furthermore, overhaul; a form of corrective maintenance that restores vehicle systems or components to the specified standards; whereas, the responsible team performs services after specific intervals of time or distance traveled by a vehicle.

Overhaul is performed when performance within a system or component declines beyond lower limits of failure. (Haghani & Shafahi,. 2002).

2.8 Condition Based Maintenance

Alaswad and Xiang (2017) state that, condition-based maintenance spots early symptoms of failures, to determine the correct time to maintain the vehicles.

It depends entirely on the real condition of a vehicle component or system. The strategy involves continuous monitoring of the systems, subsystems or components. (Haghani & Shafahi,. 2002).

The gathered information help to decide on the actions to take with respect to transport planning, management of spare parts and vehicles safety concerns. (Haghani & Shafahi,. 2002).

Ingemarsdotter et al. (2021) postulates that, condition-based maintenance considers the vehicles' performance, to anticipate probable vehicles' failures. It was indicated that, the strategy helps to prevent downtimes, thus it minimizes fleets' maintenance costs. Additionally, condition-based maintenance dwells on the theory that, 99% of assets such as vehicles and

relevant equipment, 22 show indicators before they actually fail. Thus, through monitoring and evaluation, the faults and their relevant causes can be easily identified and addressed to lengthen life spans of assets. (Haghani & Shafahi,. 2002).

Raza and Ulansky (2019) researched on how to optimize the quality of decisions related to monitored conditions by considering minimum entropy.(Haghani&Shafahi,.2002).

The research presented a condition based maintenance mathematical model, of which condition monitoring was not well conducted from time to time. Over again, results showed that, the approach used to determine preventive maintenance thresholds minimizes ambiguities in making decisions on assets' conditions, to monitor situations. (Haghani & Shafahi,. 2002).

2.9 Project Performance

Project performance has been the subject of discussions in the project management literature. According to Carvalho et al. (2015), the traditional view of project success is associated with the achievement of time, cost and quality objectives (iron triangle). However, several studies have investigated new dimensions of project success (Carvalho & Rabechini, 2015). Thus, there seems to be no simple definition for this construction, since it can be measured differently in different types of projects, from different perspectives, at different stages and in absolute or relative terms, which makes it a multidimensional construct (Carvalho et al. al., 2015).

2.9.1 Project performance measures

In order to appropriately determine project success, some set of criteria or principles are essential to act as standards guiding or regulating project success. These standards are referred to as project success criteria or project performance measures.

According to Atkinson (1999), the most conventional standard for determining project success is the ‘iron triangle’, which determines project success in terms of cost, time and quality performance. This framework of criteria has proved to be limited in that it does not focus on a wide range of project stakeholders (Shahu et al., 2012).

2.9.2 Project management practices

According to the project management institute (PMI) (2017), project management is the application of knowledge, skills, tools and techniques to project activities in order to meet the expectation of project stakeholders. For this to be achieved there is need for a good understanding of the dynamics of project management practices by project management personnel. The world is dynamic and technology driven, hence the need for project managers to be updated with contemporary issues in project management. Advances in the management sciences have made the concept of project management to evolve into a whole system of knowledge (Chan and Chan, 2000) thus making it essential for effective management of projects especially in the construction industry (Isik et al., 2008).

This could be traced to the foundation of the PMBOK (A Guide to Project Management Body of Knowledge), an initiative of the Project Management Institute which contains knowledge, methods, processes,

techniques, tools, and skills (PMI, 2017) required for effective project management.

There are ten knowledge areas identified in the PMBOK which include integration management, scope management, time management, cost management, quality management, risk management, human resource management, communication management, procurement management and stakeholder management (PMI, 2017), and these consist of more than seventy six practices (Chou and Yang, 2012).

2.10 Relationship between Fleet maintenance management & Project performance

Productivity and profitability are key factors for companies to remain competitive in today's rapidly changing world. Concomitantly, maintenance is beginning to play a more important role in many production-related industries as the impact of maintenance performance on productivity and profitability has increased (Lado and Singh, 2019; Ismail et al., 2022). Therefore, measuring the performance of maintenance activities has become a crucial part of maintenance management. Evaluating maintenance performance supports asset managers and system owners in gaining knowledge about how the outputs of maintenance processes contribute to the business goal (Parida et al., 2015), which, in turn, drives the continuous improvement of maintenance processes and strategies (Choubey et al., 2021; Marquez, 2007).

The immense importance of maintenance performance tracking has generated increasing interest in the development of a maintenance performance measurement (MPM) framework. According to Parida et al.'s

(2015, p. 15) definition, MPM is “the multidisciplinary process of measuring and justifying the value created by maintenance investment, and taking care of the organization’s stockholders’ requirements viewed strategically from the overall business perspective.” As an important and integrated part of performance measurement, an MPM framework links organizational strategy to performance measurements using a list of indicators to set criteria (Kumar et al., 2013)..

Maintenance performance indicators (MPIs) are the building blocks of an MPM framework.

They quantify maintenance performance as a measurable value and provide direct indications of whether the performance of maintenance activities meets the designated objectives. Well-defined MPIs can pave the way to the desired maintenance performance by supporting the identification of performance gaps (Muchiri et al., 2011).

However, despite the numerous resources and efforts spent on development, MPM systems often do not have enough influence to trigger decision and process changes (Muchiri et al., 2010). On the one hand, in the vast majority of cases, performance measures are overloaded with technical indicators (Rybin et al., 2020). This increases the difficulty of performance management, leaving maintenance databases and indicators undocumented or unregulated (Parida et al., 2015).

Based on the reviewed studies, the authors of this paper summarize the process of choosing a set of MPIs for an MPM framework in three sequential steps: identifying potentially relevant indicators, screening indicators according to the organizational context, and prioritizing indicators with high impacts. The number of MPIs listed in the literature is substantial, yet a widely agreed-upon methodology for deriving the indicators is still unavailable (Kumar et al., 2013, 2018; Maria and Manuela, 2017), leaving a key knowledge gap in MPI formulation.

Although the reviewed literature focuses strongly on the ranking methodologies of performance indicators based on aspects of performance evaluation, the reasoning for why one indicator is more relevant than another in the context remains implicit. Moreover, it has been observed that the data collected for performance measurement are not adequately used in decision support (Muchiri et al., 2010). On the one hand, the large number of data collected becomes a problem, as they require more sophisticated methods and algorithms to elicit useful information (Villarejo et al., 2017; Wakiru et al., 2022). On the other hand, the reviewed indicator selection methods take a one-way path from identifying to screening MPIs. Data availability is considered a filter for eliminating non-applicable indicator candidates rather than an input to derive potential indicators. Potential indicator candidates are mostly gathered through literature searches and industrial practices,

Leaving some of the available and potentially useful data behind.

Consequently, the links between selected MPIs and the focus on future performance improvement weaken. Despite the various methods for selecting and prioritizing indicators identified in the literature, there is a lack of research on developing. Comprehensive measures for evaluating maintenance processes that consider the entire cycle and are less sensitive to data availability.

To address these issues, a performance diagnostic framework that creates a mutual connection between performance aspects and maintenance data is proposed.

Structure of maintenance performance diagnostic framework Measuring maintenance performance requires time and effort. A detailed investigation of maintenance performance usually requires data from multiple sources. In some cases, data collection, data processing, and text analysis require manual work to update performance results. The lack of automated data for

the knowledge process gives rise to the need to conduct an analysis that takes days to months (Parida et al., 2015). To reduce the time and labor costs of regular performance tracking, the proposed maintenance performance diagnostic framework is designed in two parts ,

The first part of the framework focuses on the action “detect,” namely, detecting the existence of potential performance issues by measuring maintenance outcomes. For equipment types or maintenance strategies with satisfactory maintenance outcomes, additional diagnostics are not necessary; otherwise, an end-to-end investigation at the process level is carried out in the second part. The second part focuses on the action “locate,” namely, locating potential maintenance performance issues down to the process level.

The proposed multi-criteria framework has a hierarchical structure at the first three levels (diagnostic objectives, diagnostic domains, and diagnostic aspects). A top-down approach is used to properly formulate the performance measurement structure at these levels. Level 1 determines the top-level objective for the performance diagnostics for each part. Level 2 defines the major performance diagnostic viewpoints under level 1 objectives as domains. Level 3 further expands the domains into categorical diagnostic aspects. The performance result for each thematic category from levels 1–3 is represented by a qualitative indicator, which aggregates the corresponding indicators at the lower level. Level 4 (performance measurement) links MPIS to relevant diagnostic aspects at level 3, depending on the data.

Carvalho & Rabechini (2017) point out a lack of confirmatory studies about the relationship between sustainability and project performance, which are thus sought in this study. The results reinforce the perspective of a positive and significant impact among the constructs. Failing to identify a negative influence on project performance if related to costs.

2.11 Conclusion

From the results of the study, the highest relationship exists between maintenance management and project success, followed by project performance and project success, and stakeholder management and project success.

In recent years, computerized fleet management systems have been developed which allow the transit agencies to assign buses to a specific schedule, and maintain that assignment for a long period of time. When such systems are in place, the transit managers prefer that the operators drive the same bus to the extent possible.

Since the buses have fixed schedules, one can predict when they are available in the garage, and therefore, any inspection and maintenance can be accomplished when the buses...

CHAPTER THREE:

Research Methodology

3.1 Introduction:

This section outlines how each study variable was measured before outlining the data analysis strategies used to accomplish the study's goals. The data analysis method was used in this study to address the research issue. To examine the quantitative data, SPSS version 26 was used. The study used statistical data analysis software, especially SPSS version-26, to examine the data to be collected using a variety of statistical approaches. It made use of descriptive statistics like percentage, mean, median, and standard deviation as well as graphs and tables. To establish a functional relationship between the dependent variables and the independent variable, an inferential statistics multiple regression model and Pearson correlation were used.

3.2 Operational definitions for research variables:

3.2.1 Fleet Maintenance Management (The independent variable)

Operational definition: Fleet management is an important aspect of efficient business operations, and involves supervising and coordinating a company's vehicle fleet. From logistics to safety, effective fleet management is essential for businesses that rely on transportation. Getinet Abebe - June-(2023).

3.2.2 Project performance (The dependent variable)

A Project Performance Review (PPR) is a critical evaluation process that assesses the progress and performance of a project against its planned objectives and timelines. Getinet Abebe - June-(2023).

3.3 Research Design:

In this template, we'll present a structure that covers five important methodological matters (as outlined above). This structure is loosely based on “research onion”.

Research Philosophy: Positivist

Research Approach: Deductive

Research Strategy: Case Study

Research Choice: Quantitative

Time Horizon: Cross-sectional

Data Collection and Analysis Techniques: Statistical analysis and
Measurements of case results:

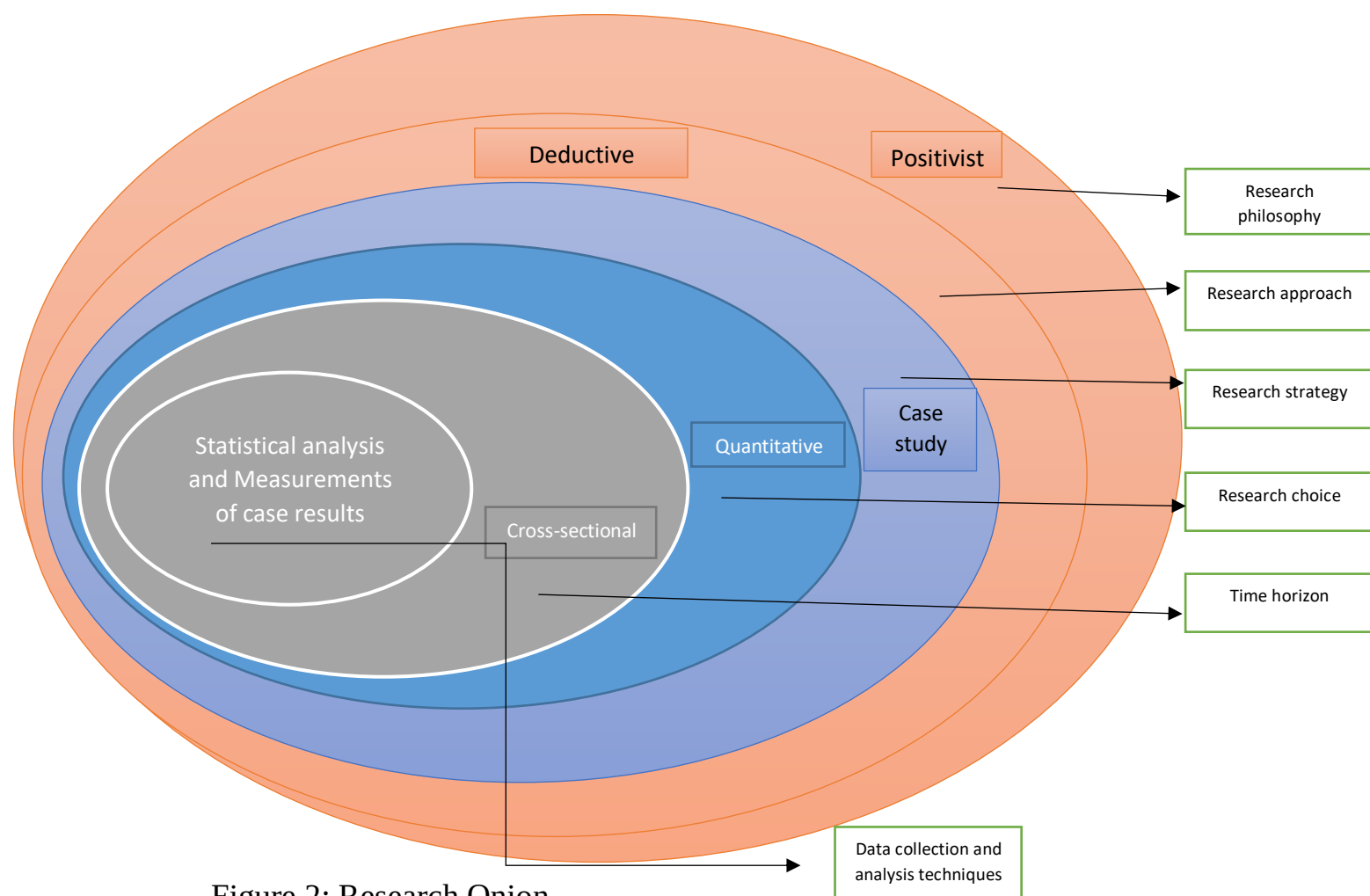


Figure 2: Research Onion

3.4. Research population & Sampling methods and technique:

This part considers the information about the study population and its sample. In addition, this part explains the methods and techniques that were developed to select the study sample and determine the sample size.

3.4.1 Population Research:

Within the framework of this study, the community was identified in SEITCO School Transport Company, which is a medium-sized, project-based company that includes 150 employees as a whole in the Medina project, divided into senior management, middle management, and low management.

Population Research	Categories	Number of Employees
SEITCO School Transport Company in Madinah Saudi Arabia	Manager	8
	Supervisor	20
	Coordinator	25
	Technician	40
	Driver	55
	Other	2
	Total	150

Table1: Source Student: Based on the website (Google Form)

3.4.2 Sample Research:

According to the table of Krejci & Morgan (1970), the population size = 150, so the study sample size = 42 managers, supervisors, coordinators, and various employees.

The research sample	Sample volume
Targeted employees of SITCO school transportation company	42

Table2: Source: Student: Targeted employees

3.4.3 Techniques & Method Sampling:

Because of the research performance used, the sampling method is probability and the sampling technique is simple random sampling.

3.5 Data collection method

The technology used:

An electronic questionnaire was designed using the Google Form platform to collect data related to the effect of fleet maintenance management on project performance. The questionnaire link was sent by email to randomly selected employees, and the employees were followed up via text messages and phone calls to ensure that the questionnaire was completed on time.

A simple random sample was tested to ensure that all segments of employees in the company were represented fairly and unbiased. This method also provided equal opportunities for all employees to participate in the study.

Using the electronic questionnaire, the process of collecting and analyzing data was facilitated in an effective and reliable manner.

The questionnaire included the following topics

1-The first axis: personal data (5 questions)

2-The second axis: fleet Maintenance management (20 questions)

3-The third axis: Project performance (18 questions)

ferries	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Degree of approval	1	2	3	4	5

Table3: Source: Student: Degree of approval

Fleet Maintenance Management (The independent variable)

The Getinet Abebe - June-(2023) questionnaire was relied upon. The independent variable in this study, fleet maintenance management, consists of five dimensions. Project performance consists of six elements, Vehicles Repair and Maintaining Practice, consists of five elements, Fuel Management System, consists of six elements, Vehicle replacement and Disposal Management, consists of four elements, Driver training and Management The type of questionnaire is a five-point Likert, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly.

Variable	Variable Dimensions	Number Of Statements	Source
Fleet Management Measurement	.Vehicles Repair and Maintaining Practice	1-6	Getinet Abebe - June-(2023) THE EFFECT OF FLEET MANAGEMENT PRACTICES ON OPERATIONAL PERFORMANCE, IN THE CASE OF DANGOTE CEMENT ETHIOPIA PLC
	.Fuel Management System	1-5	
	.Vehicle replacement and Disposal	1-6	
	Management	1-4	
	.Driver training and Management		

Table4: Source: Student: Fleet Management (The independent variable)

Project performance (The dependent variable)

The Getinet Abebe questionnaire was based on June 2023. The dependent variable in this study, project performance, consists of six elements, Cost, consists of four elements, Flexibility, consists of three elements, Service Quality, consists of four elements, Speed of service Delivery The type of

questionnaire is a five-point Likert, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly.

Variable	Variable Dimensions	Number Of Statements	Source
Project operational Performance Measurement	.Cost .Flexibility .Service Quality .Speed of Service Delivery	1-6 1-4 1-3 1-4	Getinet Abebe - June-(2023) THE EFFECT OF FLEET MANAGEMENT PRACTICES ON OPERATIONAL PERFORMANCE, IN THE CASE OF DANGOTE CEMENT ETHIOPIA PLC

Table5: Source: Student: Project performance (The dependent variable)

3.5.1 Primary data

Primary data was collected through questionnaires that were distributed to SEITCO school transportation company employees to measure their opinions about the effect of maintenance and fleet management on project performance.

3.5.2 Secondary data

Previous research, scientific dissertations, and reports that dealt with the impact of maintenance and fleet management on project performance were used in the secondary data.

3.5.3 Data analysis methods

After collecting data, it is essential to analyze the information gathered to draw meaningful conclusions. As, the Statistical Package for the Social Sciences (SPSS), specifically version 28, were used to analyze the collected data.

The sample profile test was conducted, via descriptive analysis, to gain insights into the characteristics of the sample population. It helps researchers understand the demographics, preferences, and other relevant information about the individuals involved in the study.

Validity and reliability tests are crucial in ensuring that the data collected is accurate and consistent. Validity tests (Exploratory factor analysis) to determine if the research instruments measure what they are intended to measure, while reliability tests (Cronbach's Alpha test) assess the consistency of results over time.

The sample profile test was conducted, via descriptive analysis, to gain insights into the characteristics of the sample population. It helps researchers understand the demographics, preferences, and other relevant information about the individuals involved in the study.

Chapter Four:

Statistical analysis of the study results

4.1 Introduction

This chapter presents the results of the field study that were statistically analyzed using both: SPSS statistical software package version 28. The current chapter of statistical analysis includes descriptive statistics for the sample under study using SPSS V28. Testing the validity and reliability of the questionnaires used to collect the required data from the current study sample using PLS 3.0. In addition, in order to test the research hypotheses and the suitability of the model, a simple linear regression analysis was conducted via S28.

4.2 Characteristics of the study sample

❖ The study sample items were distributed according to gender - age group - number of years of experience - nature of work - and educational level.

❖ The frequencies and percentages of the study sample individuals were calculated and represented in the demographic information that includes:

- Gender and includes (male, female).
- Age group and includes (less than 25 years, from 25 to 35 years, from 36 to 45 years, more than 45 years).
- Number of years of experience and includes (less than 5 years / from -5 to 10 years / from -11 to 20 years / from 20 years and above).
- Nature of work and includes (managers / supervisors / coordinators / drivers / technicians / other)
- Educational level and includes (secondary / diploma / university / postgraduate studies).

The following table, graphs and paragraphs clarify the classification of the sample under study, as follows:

Description of the study sample

		Gender			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	7	16.7	16.7	16.7
	Male	35	83.3	83.3	100.0
	Total	42	100.0	100.0	

From the data in Table No. (/) the following results were extracted:

- Regarding gender: The statistical results showed that the number of males is greater than the number of females, as the number of males reached 35 individuals, representing 83.33% of the total sample, while the number of females reached 7 individuals, representing 16.67% of the total sample. As shown in the following figure:

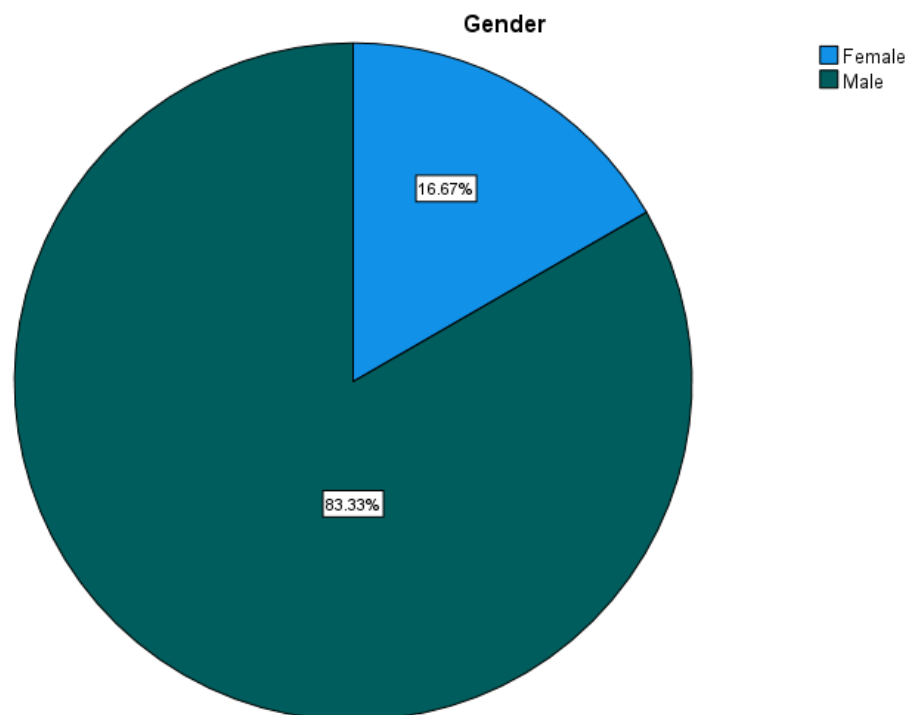


Figure3: Sample classification according to gender

		Age			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Over 45	2	4.8	4.8	4.8
	less 25	5	11.9	11.9	16.7
	25-35	13	31.0	31.0	47.6
	35-45	22	52.4	52.4	100.0
	Total	42	100.0	100.0	

- As for age: 5 items were less than 25 years old, representing 11.90%. While the age group from 25 to 35 years had 13 items, representing 30.95%. The age group from 35 to 45 years had 22 items, representing 52.38%. While the age group over 45 had 2 items, representing 4.76%. The following figure illustrates this.

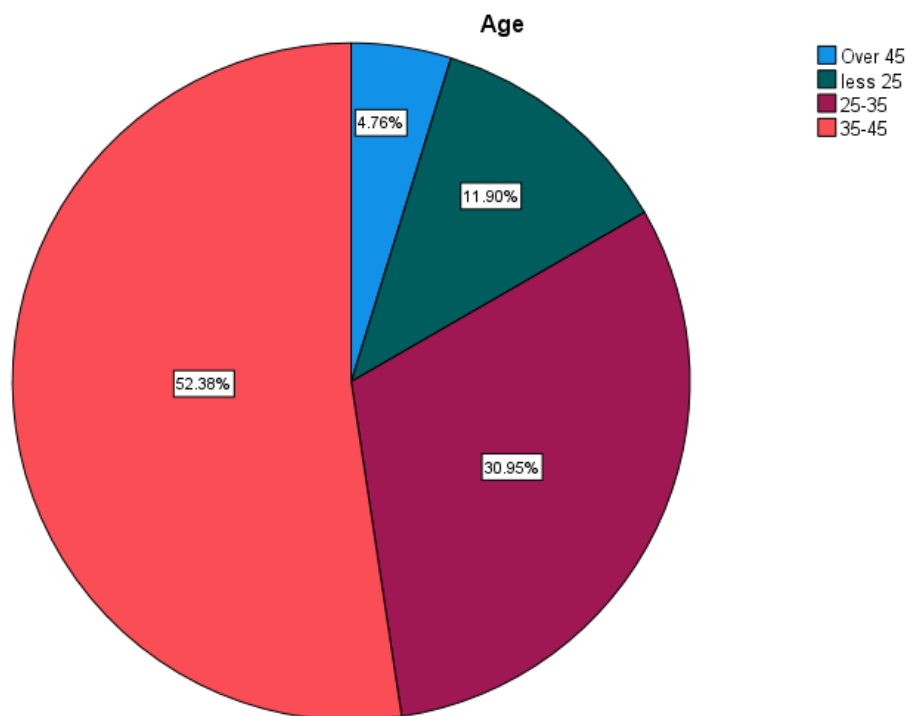


Figure4: Classification of the study sample according to age

Educational qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Master and above	1	2.4	2.4	2.4
	Diploma	8	19.0	19.0	21.4
	High school	16	38.1	38.1	59.5
	Bachelor	17	40.5	40.5	100.0
	Total	42	100.0	100.0	

- As for the educational level: The number of those holding a secondary qualification was 16 items, representing 38.10% of the total sample. While the number of those holding a diploma was 8 items, representing 19.05% of the total sample, while the number of those holding a university qualification was 17 items, representing 40.48% of the total sample. Finally, the number of those holding a postgraduate qualification was 1 item, representing 2.38% of the total sample. The following figure illustrates this.

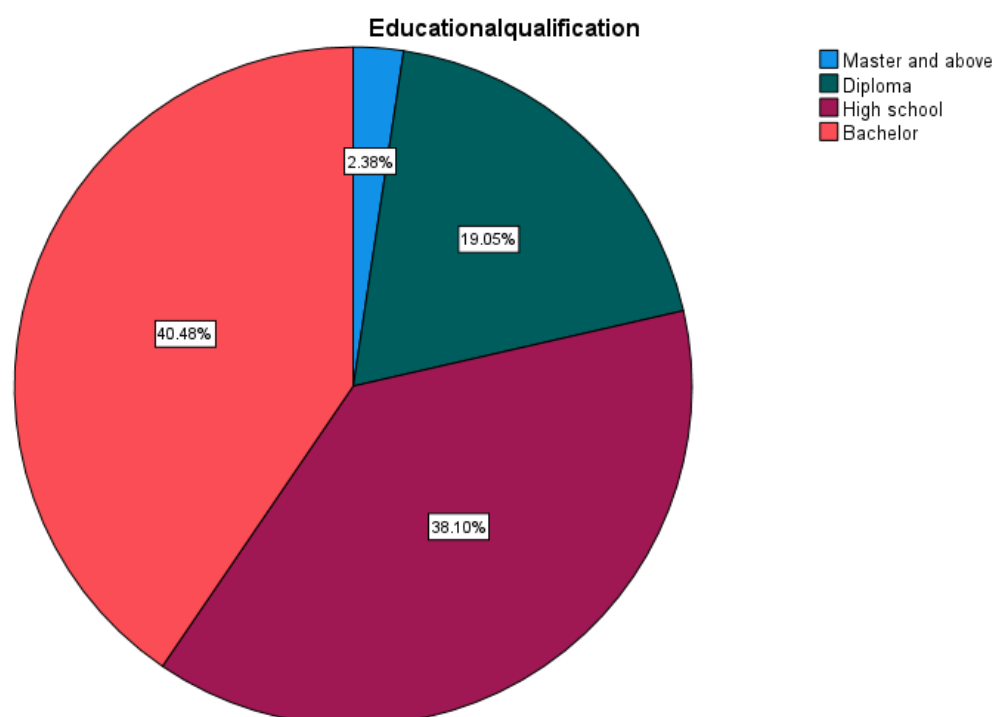


Figure5: Sample classification according to educational level

Working Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 20 year	6	14.3	14.3	14.3
	< 5 year	10	23.8	23.8	38.1
	10-20 year	11	26.2	26.2	64.3
	5 -10 year	15	35.7	35.7	100.0
	Total	42	100.0	100.0	

- Regarding the number of years of experience: 10 items had less than 5 years of experience, representing 23.8%. While the experience level from 5 to 10 years had 15 items, representing 35.7%. The experience level from 10 to 20 years had 11 items, representing 26.2%. While the experience level from 21 years or more had 6 items, representing 14.3% of the total sample. The following figure illustrates this.

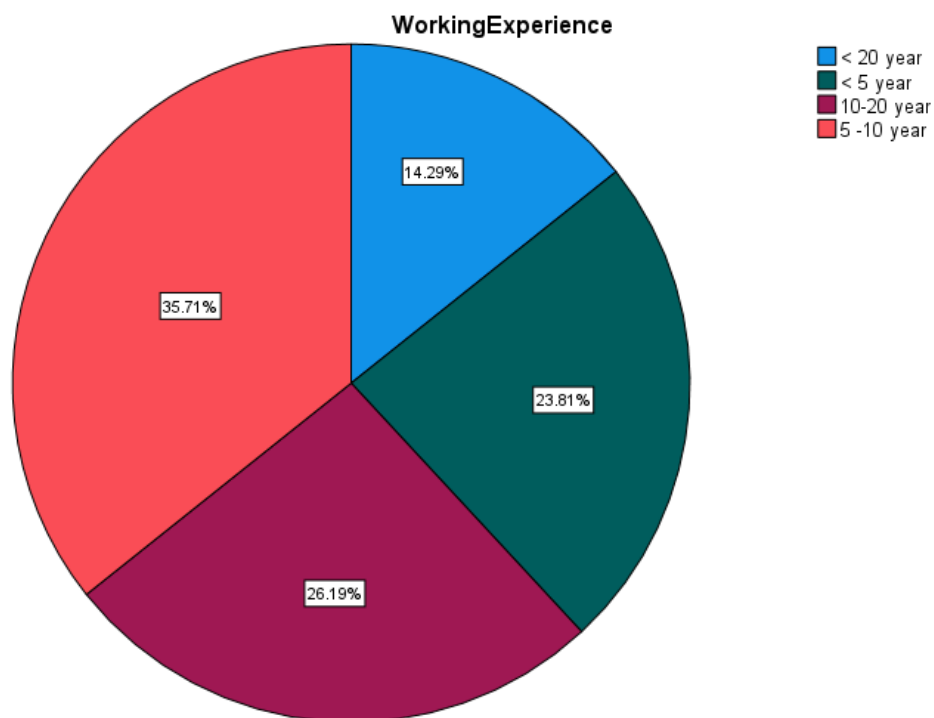


Figure6: Classification sample according to the level of experience

		Position			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Manager	2	4.8	4.8	4.8
	Driver	3	7.1	7.1	11.9
	Coordinator	5	11.9	11.9	23.8
	Others	5	11.9	11.9	35.7
	Technician	8	19.0	19.0	54.8
	Supervisor	19	45.2	45.2	100.0
	Total	42	100.0	100.0	

-Regarding the nature of work: the number of managers in the sample was 2 individuals, representing 4.8%, while the number of supervisors was 19 individuals, representing 45.2%, while the number of technicians was 8 individuals, representing 19.0%, while the number of coordinators was 5 individuals, representing 11.9%, while the number of drivers was 3 individuals, representing 7.1%. Finally, the number of others was 5 individuals, representing 11.9% of the total sample. The following figure illustrates this.

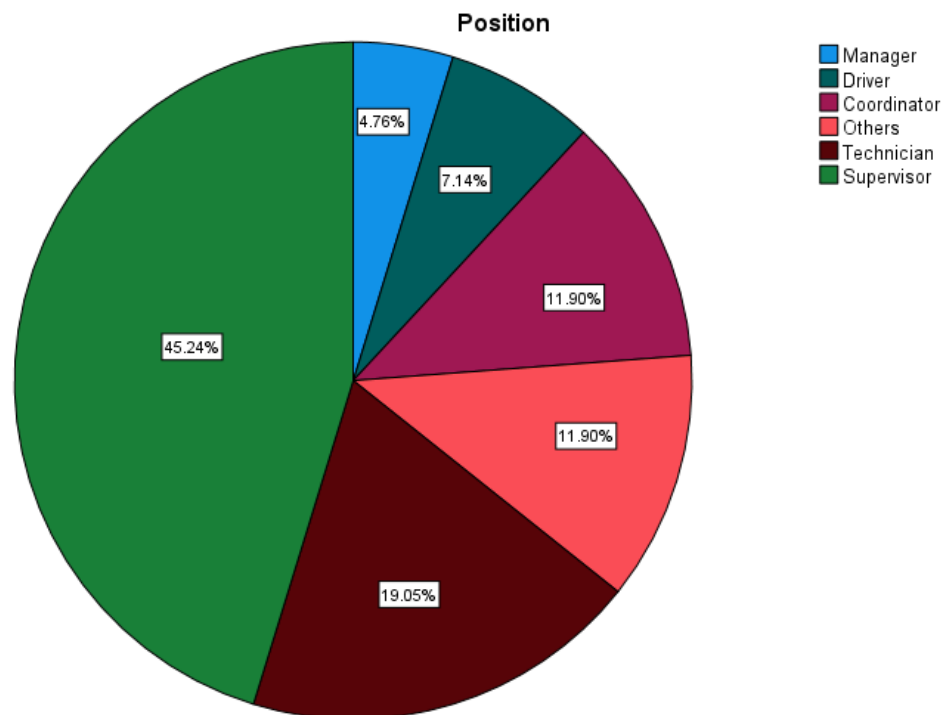


Figure7: Classification sample according to the nature of work

4.3 Measuring the validity and reliability of the study tools

In order to verify the validity and reliability of the scales used in the study, the internal consistency validity of the questionnaires used to measure the study variables was tested, in addition to measuring the convergent validity by measuring the average variance extracted (AVE (Extracted Variance Average)). While, the reliability of the scales used in the study was measured by measuring both: the Cronbach's Alpha value, the Composite reliability value, through the structural equation model (SEM) using the statistical analysis program 3.0 PLS -Smart. The following paragraphs and tables illustrate this.

4.3.1 Validity of the scales used in the study

The internal consistency validity of the scales used to measure the study variables was tested, in addition to measuring convergent validity by measuring the average extracted variance (AVE).

- Internal consistency validity: It means the extent of consistency of each statement of the questionnaire for the variable to which it belongs. Therefore, the researcher measured the internal consistency of the questionnaires by calculating the correlation coefficients between the score of each statement and the total score of the variable to which it belongs. According to the study of (1974) Kaiser, a correlation coefficient less than 0.5 is deleted from the questionnaire.
- Convergent validity: The average variance between the statements that measure the same scale is measured by calculating the average extracted variance (AVE), which must be greater than 0.5 according to (Hair et al. 2006).

The following tables show the statistical results for (correlation coefficients, standard deviation, The calculated T value, and the P-value

(between the score of each statement and the total score of the variable) to measure the internal consistency validity of the questionnaires. Also, the average extracted variance value AVE was calculated to measure the convergent validity of the questionnaires, through the structural equation model SPSS, as follows:

SPSS results for testing the internal and convergent consistency of the study variables' scales

Exploratory Factor Analysis

	Component			AVE
	Cost	Flexibility	Service Q&D	
PC1	.875			0.727625
PC2	.645			
PC3	.842			
PC4	.871			
PC5	.763			
PC6	.874			
PF1		.485		
PF2		.335		
PF3		.398		
PF4		.562		
PS1			.865	
PS2			.812	
PD1			.876	
PD2			.852	
PD3			.815	
PD4			.772	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Table6: Component Factor Analysis

Statistically significant at 0.01 (n=42 items)**

Source: Prepared by the researcher based on the results of the statistical analysis of the field study data

It is clear from the table above:

Scale of Project Performance Measurement: All correlation coefficients for all statements are strongly correlated with their dependent variable, at values greater than 0.7. In addition, the values of all correlation coefficients for the statements are statistically significant at a significance level less than 0.001. Accordingly, the internal consistency validity of the scale has been achieved. Also, from the results above related to the value of the average variance extracted AVE, it is clear that its value for the digital transformation application variable is $0.727 < 0.5$. Accordingly, the convergent validity of the questionnaire has been achieved.

SPSS results for testing the internal and convergent consistency of the study variables' scales

Exploratory Factor Analysis

Items/ constructors	Component				AVE
	Vehicles Repair and Maintaining Practice	Fuel Management System	Vehicle replacement and Disposal Management	Driver training and Management	
FV1	.830				0.696905
FV2	.724				
FV3	.777				
FV4	.803				
FV5	.779				
FV6	.673				
FF1		.639			
FF2		.515			
FF3		.505			
FF4		.716			
FF5		.549			
FM1			.599		
FM2			.605		
FM3			.806		
FM4			.847		
FM5			.813		
FM6			.745		
FD1				.626	
FD2				.669	
FD3				.533	
FD4				.882	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimaxwith Kaiser Normalization.

a. Rotation converged in 8 iterations.

Table7: Exploratory Factor Analysis

▪ Maintenance Planning and Fleet Management Practices Scale: All correlation coefficients for the statements measuring the maintenance and fleet management practices variable (periodic Maintaining Practice function, fleet function, Fuel Management System function) have values greater than 0.7, in addition to the fact that the values of all correlation coefficients for the statements are statistically significant at a significance

level less than 0.001. Accordingly, the internal consistency validity of the scale in its three dimensions has been achieved. Also, from the above results related to the value of the average variance extracted AVE for the maintenance and fleet management practices variable as a whole, which is equal to 0.736, the values of the average variance extracted for the dimensions of maintenance and fleet management practices (periodic Maintaining Practice function, fleet function, Fuel Management System function) are: , 0.696 respectively. Accordingly, the convergent validity of the questionnaire has been achieved.

4.3.2 Stability of the study tool

Questionnaire stability refers to: the stability of the questionnaire results and not changing them significantly if they were redistributed to the sample individuals several times during specific time periods. To measure the stability of the questionnaires used to measure the study variables, the values of Cronbach's alpha and composite reliability were calculated using the SPSS structural equation model. According to (2010) al et Hair, the three values must be greater than 0.7 for the scale to be stable. The following table shows the values extracted from the SPSS structural equation regarding the three values (Cronbach's alpha and composite reliability).

Table8: Measurement of reliability of study tools

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.982	.982	21

Source: Prepared by the researcher based on the results of statistical analysis of field study data. N = 42 individuals

The table above shows that the values of the reliability coefficients for the study scales are as follows:

- **Project Performance Scale:** The statistical results showed that the values of (Cronbach's alpha, reliability Composite) are: 0.973, 0.973 respectively. This indicates that all values are greater than 0.7. According to (Hair et al., 2010), the reliability of the scale has been achieved.
- **Maintenance and Fleet Management Practices Scale:** The statistical results showed that the values of (Cronbach's alpha, reliability Composite) for the scale as a whole are: 0.982, 0.982 respectively. Also, the values of (Cronbach's alpha, reliability Composite)

According to the statistical results above, which proved the validity and reliability of the scales used in the current study, which means the possibility of relying on its results and the validity of these questionnaires for application and trust, and using them in conducting analyses to test the study hypotheses.

4.4 Descriptive analysis of study variables

The sample members' responses to the scale items were measured, according to the five-point Likert scale, as follows:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

The level of importance was calculated according to the following equation:

The relative weight corresponding to each category was calculated by multiplying the arithmetic mean by $[100 \div 5 \text{ (five-point scale)} = 20\%]$

The following table shows the significance of the arithmetic means, as follows:

The significance of arithmetic means

Arithmetic mean value	Result (General Trend)	Relative weight%	Level (degree) of practice/importance
1 to less than 1.80	Totally disagree	From 20 to less than 36%	too low
n 1.80 to less than 2.60	Disagree	From 36 to less than 52%	low
n 2.60 to less than 3.40	neutral	From 52 to less than 68%	middle
n 3.40 to less than 4.20	Agree	From 68 to less than 84%	high
n 4.20 to less than 5	Strongly Agree	From 84 to 100%	too high

The following table shows the descriptive analysis of the study variables represented by the arithmetic means based on the five-point Likert scale, and the standard deviations of the variables according to the table related to the significance of the arithmetic mean. The significance of the arithmetic mean shown in the table above is considered to know the level of project performance as well as the level of maintenance practices and fleet management and their dimensions, according to the point of view of the study sample, as follows:

Arithmetic means and standard deviations of the study variables

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PerformanceC	42	1	5	3.65	.197	1.279	1.637
PerformanceF	42	1	5	3.48	.197	1.278	1.632
PerformanceS	42	1	5	3.53	.203	1.313	1.724
PerformanceD	42	1	5	3.55	.211	1.367	1.870
Project_Performance_Measurement	42	1	5	3.57	.185	1.196	1.431
Valid N (listwise)	42						

Variables	Arithmetic mean	Standard deviations	General trend	Level of importance/practice
Project Performance	3.57	1.196	Agree	high

Arithmetic means and standard deviations of the study variables

Descriptive Statistics							
	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
FleetV	42	1	5	3.90	.199	1.289	1.661
FleetF	42	1	5	3.50	.199	1.288	1.659
FleetM	42	1	5	3.66	.217	1.405	1.975
FleetD	42	1	5	3.38	.206	1.333	1.778
Fleet_Management_Measure ment	42	1	5	3.64	.191	1.240	1.537
Valid N (listwise)	42						

Variables	Arithmetic mean	Standard deviations	General trend	Level of importance/practice
Fleet_Management	3.64	1.240	Agree	high

The table above for the arithmetic averages and standard deviations of the study variables shows the following:

- The results of describing the independent variable (fleet maintenance management): show that the general trend of the study sample items is approval, which indicates the achievement of a high level of fleet maintenance management in the transportation sector, as the arithmetic average of the sample members' opinions was (3.64) with a high approval rate of 72.80%, at a standard deviation of (1.240).
- As for describing the dependent variable (project performance): The results showed that the general trend of the study sample items is approval, which indicates the achievement of a high level of project performance in the transportation sector. The arithmetic average of the variable as a whole was (3.57) with an approval rate of (71.40%) at a standard deviation of (1.196). The descriptive statistical results of the dimensions also showed

According to the descriptive results of the study variables, the descriptive statistical results regarding the independent variable (fleet maintenance management) indicated that the general trend among the study sample is approval and that its application in the sector is high, while the descriptive statistical results for the dependent variable (project performance) and its dimensions were at a high level in the transportation sector, from the point of view of the study sample.

4.5 Correlation coefficients between study variables

The following table shows the linear correlation coefficients (Pearson) between study variables, which were measured using SPSS-V28 as follows.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.898
Bartlett's Test of Sphericity	Approx. Chi-Square	920.797
	df	136
	Sig.	<.001

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.735
Bartlett's Test of Sphericity	Approx. Chi-Square	1470.515
	df	210
	Sig.	<.001

❖ Linear correlation between fleet maintenance management (as an independent variable) and project performance practices and dimensions (as a dependent variable):

- It was found that there is a strong positive significant correlation (.940) between fleet maintenance management as an independent variable and project performance practices (total) as a dependent variable at a significance level of less than (0.01).

- It was found that there is a strong positive significant correlation between fleet maintenance management as an independent variable and each dimension of project performance (FV, FF, FM and FD) at a correlation coefficient of: 0.859, 0.907, 0.892, 0.836 respectively, as dependent variables at a significance level of less than (0.01).

- It is noted from the above that the values of the correlation coefficients between the study variables are high, which indicates the strength of this correlation.

❖ Linear correlation between the dimensions of fleet maintenance management practices and the variable of fleet maintenance management practices as a whole, and between each other: The results of the previous table show that there is a significant positive correlation between fleet maintenance management practices and its dimensions (PC, PF, PS and PD) at a significance level of (0.01).

4.6 Study Hypothesis Test Results

This section deals with testing the validity of the main hypothesis of the study and its sub-hypotheses. The statistical results obtained using the statistical package SPSS, 28V are presented as follows:

The main hypothesis of the study:

- There is a statistically significant positive relationship between fleet maintenance management and project performance practices in the transportation sector.

This main hypothesis has sub-hypotheses as follows:

- ☐ F1: There is a positive statistically significant relationship between fleet maintenance management and PC.
- ☐ F2: There is a positive statistically significant relationship between fleet maintenance management and PF.
- ☐ F3: There is a positive statistically significant relationship between fleet maintenance management and PS.
- ☐ F3: There is a positive statistically significant relationship between fleet maintenance management and PD.

Results of testing the main hypothesis of the study:

This hypothesis states that "- There is a positive relationship with statistical significance between fleet maintenance management and project Performance in the transportation sector."

To test this hypothesis, the simple linear regression analysis method was used between the fleet maintenance management under study as an independent variable and the project performance (overall) as a dependent variable.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.940 ^a	.883	.880	.415

a. Predictors: (Constant), Fleet_Management

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.781	1	51.781	300.934	<.001 ^b
	Residual	6.883	40	.172		
	Total	58.664	41			

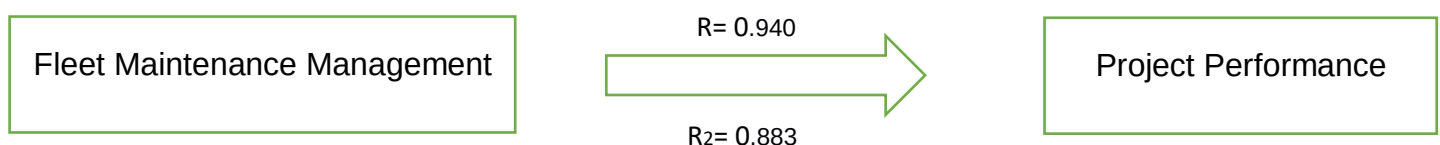
a. Dependent Variable: Project_Performance

b. Predictors: (Constant), Fleet_Management

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.269	.201		1.342	.187	-.136	.674
	Fleet_Management	.906	.052	.940	17.347	<.001	.801	1.012

a. Dependent Variable: Project_Performance



The tables above show the following:

- The significance level of the F test (F.sig) is less than (0.01), which indicates the significance of the simple linear regression model at a significance level of 0.01.
- The correlation coefficient value ($R = 0.787$) indicates a strong positive correlation between fleet maintenance management and project performance (total).
- The adjusted coefficient of determination (R^2) indicates that (88%) of the variance in project performance (total) can be explained by the variance in the level of digital transformation implementation.
- The value of (T) indicates the significance of the regression coefficient beta (β), as the significance level calculated for the (T) test is less than (0.01).

The main structure states that there is a positive correlation with statistical significance between fleet maintenance management as an independent variable and project performance (total) as a dependent variable.

Results of the project performance costs sub-hypothesis test of the study:

This hypothesis states that: “There is a positive and statistically significant relationship between fleet maintenance management and project performance costs.” This hypothesis tests the direct relationships between fleet maintenance management under study as an independent variable, and project performance costs as a dependent variable. To test this hypothesis, the simple linear regression analysis method was used.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.821 ^a	.674	.638	.769

a. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45.209	4	11.302	19.102	<.001 ^b
	Residual	21.892	37	.592		
	Total	67.101	41			

a. Dependent Variable: PerformanceC

b. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.882	.387		2.280	.028	.098	1.667
	FleetV	.007	.175	.007	.042	.966	-.348	.362
	FleetF	-.004	.249	-.004	-.016	.987	-.508	.500
	FleetM	.713	.205	.783	3.475	.001	.297	1.129
	FleetD	.042	.178	.043	.234	.816	-.319	.403

a. Dependent Variable: PerformanceC

Fleet Maintenance Management

R = 0.787

R² = 0.620

Project Performance Cost

The tables above show the following:

- The significance level of the F test (F.sig) is less than (0.01), which indicates the significance of the simple linear regression model at a significance level of 0.01.
- The correlation coefficient value ($R = 0.787$) indicates a strong positive correlation between fleet maintenance management and project performance Cost (total).
- The adjusted coefficient of determination (R^2) indicates that (67%) of the variance in project performance Cost (total) can be explained by the variance in the level of digital transformation implementation.
- The value of (T) indicates the significance of the regression coefficient beta (β), as the significance level calculated for the (T) test is less than (0.01).

The main structure states that there is a positive correlation with statistical significance between fleet maintenance management as an independent variable and project performance Cost (total) as a dependent variable.

Results of the project performance flexibility sub-hypothesis test of the study:

This hypothesis states that: “There is a positive and statistically significant relationship between fleet maintenance management and project performance flexibility (recruitment, selection and appointment).” This hypothesis tests the direct relationships between the maintenance management of the project under study as an independent variable, and project performance flexibility (”) as a dependent variable. To test this hypothesis, the simple linear regression analysis method was used.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.897 ^a	.805	.783	.595

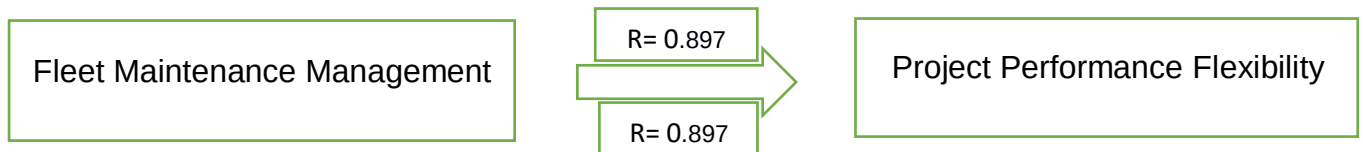
a. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53.841	4	13.460	38.066	<.001 ^b
	Residual	13.083	37	.354		
	Total	66.924	41			

a. Dependent Variable: PerformanceF

b. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF



The tables above show the following:

- The significance level of the F test (F.sig) is less than (0.01), which indicates the significance of the simple linear regression model at a significance level of 0.01.
- The value of the correlation coefficient ($R = 0.743$) indicates a strong positive correlation between fleet maintenance management and project performance flexibility.
- The adjusted coefficient of determination (R^2) indicates that (80.50%) of the variance in the recruitment function (recruitment and appointment) can be explained by the variance in the level of digital transformation implementation.
- The value of (T) indicates the significance of the regression coefficient beta (β). Since the calculated significance level for the (t) test is less than (0.01). Based on the previous results, the validity of the second sub-hypothesis is accepted, which states that there is a positive correlation with statistical significance between fleet management as an independent variable and project performance flexibility as a dependent variable.

Coefficients ^a							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.146	.285	.513	.611	-.430	.722
	Fleet_Management	.917	.074	.890	<.001	.767	1.067

a. Dependent Variable: PerformanceF

Results of the service quality sub-hypothesis test of the study:

This hypothesis states that: "There is a positive and statistically significant relationship between fleet maintenance management and service quality." This hypothesis tests the direct relationships between fleet maintenance management under study as an independent variable and service quality as a dependent variable. To test this hypothesis, the simple linear regression analysis method was used.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.949 ^a	.900	.889	.438

a. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63.591	4	15.898	82.978	<.001 ^b
	Residual	7.089	37	.192		
	Total	70.680	41			

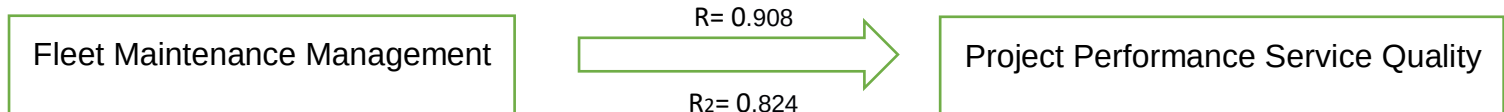
a. Dependent Variable: PerformanceS

b. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.045	.220		-.206	.838	-.492	.401
	FleetV	.304	.100	.299	3.054	.004	.102	.506
	FleetF	.440	.142	.431	3.106	.004	.153	.727
	FleetM	-.225	.117	-.241	-1.929	.061	-.462	.011
	FleetD	.496	.101	.504	4.891	<.001	.291	.702

a. Dependent Variable: PerformanceS



The above tables show the following:

- The significance level of the F test (F.sig) is less than (0.01), which indicates the significance of the simple linear regression model at a significance level of 0.01.
- The value of the correlation coefficient ($R = 0.740$) indicates a strong positive correlation between fleet maintenance management and Service Quality.
- The adjusted coefficient of determination (R^2) indicates that (90.8%) of the variance in Service Quality can be explained by the variance in the level of fleet maintenance management.
- The value of (T) indicates the significance of the regression coefficient beta (β). Since the calculated significance level for the (t) test is less than (0.01). Based on the previous results, the validity of the second sub-hypothesis is accepted, which states that there is a positive correlation with statistical significance between fleet maintenance management as an independent variable and Service Quality as a dependent variable.

Results of testing the fourth sub-hypothesis of the study:

This hypothesis states that: “There is a positive and statistically significant relationship between fleet maintenance management and service delivery speed.” This hypothesis tests the direct relationship between fleet maintenance management under study as an independent variable and service delivery speed as a dependent variable. To test this hypothesis, a simple linear regression analysis method was used.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.920 ^a	.846	.830	.564

a. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64.884	4	16.221	50.991	<.001 ^b
	Residual	11.770	37	.318		
	Total	76.655	41			

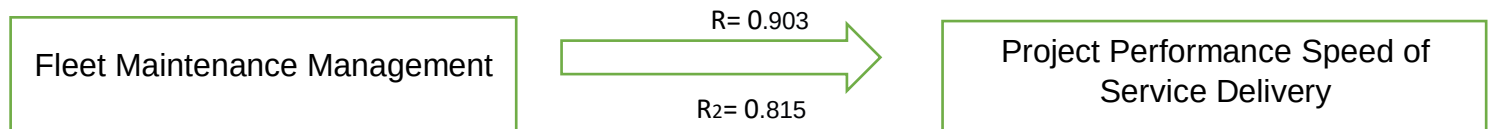
a. Dependent Variable: PerformanceD

b. Predictors: (Constant), FleetD, FleetV, FleetM, FleetF

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.213	.284		-.751	.457	-.788	.362
	FleetV	.436	.128	.411	3.393	.002	.176	.696
	FleetF	.617	.182	.581	3.380	.002	.247	.986
	FleetM	-.097	.150	-.099	-.641	.525	-.401	.208
	FleetD	.077	.131	.075	.586	.562	-.188	.341

a. Dependent Variable: PerformanceD



The above tables show the following:

- The significance level of the F test (F.sig) is less than (0.01), which indicates the significance of the simple linear regression model at a significance level of 0.01.
- The value of the correlation coefficient ($R = 0.740$) indicates that there is a strong positive association between fleet maintenance management and speed of service delivery.
- The adjusted coefficient of determination (R^2) indicates that (84.8%) of the variance in service quality can be explained by the variance in the level of fleet maintenance management.
- The value of (T) indicates the importance of the regression coefficient beta (β). Since the significance level calculated for the (t) test is less than (0.01). Based on the previous results, the validity of the fourth sub-hypothesis is accepted, which states that there is a positive and statistically significant association between fleet maintenance management as an independent variable and speed of service delivery as a dependent variable.

4.7 Conclusion

This quantitative research is a study of the relationship of fleet maintenance management to employees in the SEITCO school transportation company. This private company was chosen as the research community due to its prominent location in the region and its distinguished business reputation. The study population consisted of all 150 working and administrative employees at SEITCO Transport Company. A simple random sampling method was used to test a representative sample of the original community. An electronic questionnaire was distributed using the Google Forms platform to 42 administrative employees, which is equivalent to 28% of the total study population.

A five-point Likert scale was used to measure employees' responses to the questionnaire items, and the validity and reliability of the tool was confirmed before distributing it to the sample.

The results of the study showed that there is a positive relationship with statistical significance between the fleet maintenance management followed by SEITCO and the level of project performance of the employees.

It was also shown that the fleet maintenance management has a significant impact on motivating employees and improving their productivity.

For the statistical analysis of the data of the current study, both SPSS & PLS-SEM 28V programs were used. The researcher conducted a descriptive analysis of the study sample, and also conducted a descriptive analysis of the study changes. According to the results of the statistical analysis of this study, the validity and reliability of the criteria used in measuring the study formulas were verified. Also, the main hypothesis of the computer and the four sub-hypotheses were proven.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The aim of this research was to examine effects of vehicles' maintenance practices on facilitating Projects Performance in Saudi Arabia. On the basis of analysis taken, it can be established that there is a great need to invest substantially in vehicles' maintenance. This is because, it helps to retain vehicles' availability and reliability. More than that, efficiency and effectiveness in vehicles' operations contribute much in enhancing organizational operations .

Major findings of this research are discussed in-line with each research objective. This section also includes allied conclusions, whereby each objective or research question was considered. Again, recommendations regarding research findings were made accordingly. Generally, this part covers overviews of entire research work.

5.2 Research Limitations & Future Research

The current research aimed to examine effects of vehicles' maintenance on the performance of Project in Saudi Arabia, a case of Madinah City. Further researches could be done on other specifics such as how can fleet management affect profitability of transportation firms and the like as an additional factor on the performance of Project. The reason being, as vehicles get older, they tend to increase their running costs. Thus relevant research shall address the problem.

Conversely, maintenance such as overhauling an old engine consumes a lot of money, but that extends significantly life cycle of a particular engine. Thus, this type of maintenance should be given its priority accordingly. The reason is, this works-out cheaper than purchasing new vehicles.

5.3 Recommendations

The Ministry of Works and Transportation should set policies that guide vehicles' maintenance and their management practices. This is due to the fact that, unworthy vehicles are among the causes of road accidents and traffic jams, which in turn affect National Economy. This dictate the sector to engage enough-well trained and skilled workforces in vehicles maintenance and management roles.

The transportation firms should own modern tools, equipment and facilities such as PDM and CMMS in their vehicles' fleets' management roles. This can only be achieved through allocation of enough funds for vehicles maintenance and management activities. As a result, number of vehicles being grounded, as a consequence of lacking proper maintenances can be significantly be reduced.

Both public and private firms should use preventive maintenance strategy to enhance durability and reliability of vehicles over the corrective maintenance counterpart, since it increases vehicles' availability, reduces overall repair costs, minimizes fuel consumption, and lessens disruptions in the transportation activities. Generally, choice of appropriate maintenance programs is very important for transportation companies to consider. Decision to choose one should base on organizational policies, nature of activities and other necessities, based on specific types of vehicles.

In addition, transportation firms should set well-timed and sufficient maintenance schedules since they considerably increase vehicles' availability, reliability and safety. The use of appropriate maintenance tools should also be a mandatory, to prevent failures that may be likely to occur, as a result of opting poor maintenance strategies.

The firms should use Computerized Maintenance Management Systems or programs in facilitating maintenance management activities. These

programs are effective and simple to use to manage maintenance operations. This is because, they need minimum effort and resources utilization.

Transportation companies should make improvements to enhance communications and reactions to maintenance requirements whenever they arise. Again, maintenance records and schedules need to involve specific key performances indicators and reminders. In a similar way, maintenance systems should be linked with vehicles, to enable operators to get informed, whenever the vehicles need to undergo maintenance. In addition, these systems should contain activity costing and budgeting functions to further simplify the vehicles' maintenance management role.

Basing on the research findings, the following specific approaches are recommended in undertaking the vehicles' maintenance activities:

- i. Both public and private companies and organizations should enhance corrective maintenance by giving proper attentions as it is highly affecting the performance of the fleet operations.
- ii. Transportation firms and relevant stakeholders should use preventive maintenance plan properly to improve the performance of the fleet operations.
- iii. Owners of garages or service stations should hire skilled vehicles' maintenance staff.
- iv. Transportation firms should allocate enough budgets for vehicles' maintenances activities.
- v. Maintenance personnel should attend regular trainings so as to comply with vehicles maintenance requirements and changes in automotive technology.

5.4 Summary of Findings

This research achieved three specific objectives as they were explained in chapter one. The first one was examining effects of preventive maintenance on the performance of fleets operations in Saudi Arabia. Secondly, to investigate effects of corrective maintenance on the performance of Project in Saudi Arabia and examining effects of condition based maintenance on the performance of Project in Saudi Arabia. Madinah city was taken as a case study.

The research was guided by three predicting variables; preventive maintenance, corrective maintenance, and condition based maintenance, which were tested in relation to the performance of Project being a dependent variable. Research employed survey cross-section research design. The quantitative data were collected using structured questionnaires. Engagement involved a sample of 150 respondents through simple random and purposive sampling techniques. These were presented and analyzed by Statistical Package for Social Sciences (SPSS) program version 28 through descriptive statistical methods. Furthermore, inferential statistics multiple regression analysis were used to establish relationships between constructs with the exploration of objectives.

Results revealed independent variables; preventive maintenance, corrective maintenance and conditional based maintenance being statistically significant joint predictors of Priject Performance in Madinah. This was marked with a correlation, r of 57.7% and coefficient of determination, R^2 of 33.3%. Thus, predictor variables jointly explained 33.3% of variation on performance of fleets operations. Again, 66.7% couldn't due to effects of other variables .

Furthermore, two independent variables were unique; significant and positively influenced the performance of Project. Therefore, corrective

maintenance and preventive maintenance have positive and significant effects on the performances of Project in Madinah, Saudi Arabia .

On the other hand, condition based maintenance affects negatively Project in Madianh.

5.5 Conclusion

Basing on research findings, preventive maintenance and corrective maintenance significantly influence performance of fleets operations. This could mean that, a vehicle cannot be utilized to its optimum, if the worthwhileness doesn't meet standard limits. This should be observed throughout vehicles' useful life phases. Also, condition based maintenance indicated insignificant influence of Project Performance in Saudi Arabia. Thus, it should only be used when it is proved to be appropriate.

6. Reference

Vujanović, D., Momčilović, V., Bojović, N., & Papić, V. (2012). Evaluation of vehicle fleet maintenance management indicators by application of DEMATEL and ANP. *Expert Systems with Applications*, 39(12), 10552-10563.

DOI: <https://doi.org/10.1016/j.eswa.2012.02.159>

Alawaysheh, I., Alsyuf, I., Tahboub, Z. E. A., & Almahasneh, H. S. (2020). Selecting maintenance practices based on environmental criteria: a comparative analysis of theory and practice in the public transport sector in UAE/DUBAI. *International Journal of System Assurance Engineering and Management*, 11, 1133-1155. DOI: <https://doi.org/10.1007/s13198-020-00964-1>

Zhu, G., Gelders, L., & Pintelon, L. (2002). Object/objective-oriented maintenance management. *Journal of quality in maintenance engineering*, 8(4), 306-318. <https://doi.org/10.1108/1355251021048513>

Zhu, G., & Pintelon, L. (2001). Integrated production maintenance management (IPMM) as an enterprise approach to maintenance management. *Proceedings on CD*. DOI: <https://doi.org/10.1108/1355251021048513>

Cassady, C. R., Murdock, W. P., Nachlas, J. A., & Pohl, E. A. (1998, October). Comprehensive fleet maintenance management. In *SMC'98 conference proceedings. 1998 IEEE international conference on systems, man, and cybernetics* (Cat. No. 98CH36218) (Vol. 5, pp. 4665-4669). IEEE. DOI: <https://doi.org/10.1109/ICSMC.1998.727588>

Khalid, A. S., Hassan, N. H., Razak, N. A. A. B., & Baharuden, A. F. (2020, January). Business intelligence dashboard for driver performance in fleet management. In Proceedings of the 2020 11th International Conference on E-Education, E-Business, E-Management, and E-Learning (pp. 347-351).DOI: <https://doi.org/10.1145/3377571.3377642>

Tubis, A., & Werbińska-Wojciechowska, S. (2015). Concept of controlling for maintenance management performance: a case study of passenger Transportation Company. In Safety and reliability of complex engineered systems proceedings of the 25th European Safety and Reliability Conference, ESREL (pp. 1055-1063).ISBN 978-1-138-02879-1

Bivona, E., & Montemaggiore, G. B. (2005, July). Evaluating fleet and maintenance management strategies through system dynamics model in a city bus company. In International System Dynamics Conference, Boston, MA (pp. 17-21).

Haghani, A., & Shafahi, Y. (2002). Bus maintenance systems and maintenance scheduling: model formulations and solutions. Transportation research part A: Policy and Practice, 36(5), 453-482. DOI: [https://doi.org/10.1016/S0965-8564\(01\)00014-3](https://doi.org/10.1016/S0965-8564(01)00014-3)

Ge, J., Sigsgaard, K. V., Andersen, B. S., Mortensen, N. H., Agergaard, J. K., & Hansen, K. B. (2024). An adaptable end-to-end maintenance performance diagnostic framework. International Journal of Quality & Reliability Management, 41(2), 732-753.DOI: <https://doi.org/10.1108/IJQRM-02-2022-0071>

Parida, A., Kumar, U., Galar, D. and Stenström, C. (2015), “Performance measurement and management for maintenance: a literature review”,

Journal of Quality in Maintenance Engineering, Vol. 21, DOI: 10.1108/JQME-10-2013-0067

Kumar, U., Galar, D., Parida, A., Stenström, C. and Berges, L. (2013), “Maintenance performance metrics: a state-of-the-art review”, Journal of Quality in Maintenance Engineering, Vol. 19 No. 3, pp. 233-277, DOI: 10.1108/JQME-05-2013-0029.

Villarejo, R., Johansson, C.-A., Leturiondo, U., Simon, V., Seneviratne, D. and Galar, D. (2017), “Bottom to top approach for railway KPI generation”, Management Systems in Production Engineering, Vol. 25 No. 3, pp. 191-198, DOI: 10.1515/mspe-2017-0028.

Lado, A.K. and Singh, V.V. (2019), “Cost assessment of complex repairable system consisting two subsystems in series configuration using Gumbel Hougaard family copula”, International Journal of Quality and Reliability Management, Vol. 36 No. 10, pp. 1683-1698, DOI: 10.1108/IJQRM-12-2018-0322.

Rybin, M.V., Stepanov, A.A. and Morozova, N.V. (2020), “The system of key performance indicators of innovative activity as management innovation in oil and gas companies”, Lecture Notes in Networks and Systems, Vol. 115, DOI: 10.1007/978-3-030-40749-0_72

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. International journal of project management, 17(6), 337-342. DOI: [https://doi.org/10.1016/S0263-7863\(98\)00069-6](https://doi.org/10.1016/S0263-7863(98)00069-6)

Byrne, B. M. (2013). Structural equation modeling with Mplus: Basic concepts, applications, and programming. routledge. DOI: <https://doi.org/10.4324/9780203807644>

Chan, E. H., & Chan, A. T. (1999). Imposing ISO 9000 quality assurance system on statutory agents in Hong Kong. *Journal of construction engineering and management*, 125(4), 285-291.DOI: [https://doi.org/10.1061/\(ASCE\)0733-9364\(1999\)125:4\(285\)](https://doi.org/10.1061/(ASCE)0733-9364(1999)125:4(285))

Isik, Z., Arditi, D., Dikmen, I., & Birgonul, M. T. (2009). Impact of corporate strengths/weaknesses on project management competencies. *International Journal of Project Management*, 27(6), 629-637.DOI: <https://doi.org/10.1016/j.ijproman.2008.10.002>

Konchar, M., & Sanvido, V. (1998). Comparison of US project delivery systems. *Journal of construction engineering and management*, 124(6), 435-444.DOI:[https://doi.org/10.1061/\(ASCE\)0733-9364\(1998\)124:6\(435\)](https://doi.org/10.1061/(ASCE)0733-9364(1998)124:6(435))

Shahu, R., Pundir, A. K., & Ganapathy, L. (2012). An empirical study on flexibility: A critical success factor of construction projects. *Global Journal of Flexible Systems Management*, 13, 123-128.DOI: <https://doi.org/10.1007/s40171-012-0014-5>

Carvalho, M. M., Patah, L. A., & Souza Bido, D. (2015). Project management and its effects on project success: cross-country and cross-industry comparisons. *International Journal of Project Management*, 33(7), 1509-1522. <http://dx.doi.org/10.1016/j.ijproman.2015.04.004>

Carvalho, M. M., & Rabechini, R., Jr. (2017). Can project sustainability management impact project success? An empirical study applying a contingent approach. *International Journal of Project Management*, 35(6),

1120-1132.<http://dx.doi.org/10.1016/j.ijproman.2017.02.018>

Hair, J.F. Jr, Black, W.C., Babin, B.J. and Anderson, R.E. (2010), Multivariate Data Analysis: A Global Perspective, 7th ed., Pearson Prentice Hall, Upper Saddle River, NJ. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L., (2006). Multivariate data analysis (Vol. 6). Kaiser, H.F., (1974). An index of factorial simplicity. Psychometrika, 39(1), pp.31-36

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<https://forms.gle/6KwgDDdwQF5gZizy8>

7. Appendices

ANNEX I: Questionnaire

MIDOCEAN University

Department of Project Management

Research Title: Analysis of fleet maintenance management practices and its effect on project performance of SEITCO company school bus transportation.

Dear Respondents!

First of all, I would like to express my appreciation for your kind cooperation in providing me with relevant information.

The hereby attached questionnaire is dedicated to the Scientific Research aimed to analysis of fleet maintenance management practices and its effect on project performance of SEITCO Company. I am student's bachelor of project management. The purpose of this study investigates and examines the effect of fleet management practices and its effect on project performance of SEITCO Company Saudi Arabia.

The information gathered through this questionnaire will be used strictly for academic purposes. Your careful and honest response determines the success of the study. Thus, you are kindly requested to complete the questionnaire carefully and honestly. Your response will be kept confidential.

The questionnaire has been designed to utilize a maximum of five minutes to complete. No names required to be appeared and anonymity is guaranteed. Please read the instructions and each item in the questionnaire carefully before you give a response.

I thank you so much for your willingness, cooperation, and support.

Researcher
Ahmed Abdulrhman Alseeni

Supervisor Dr.
Mona Moustafa Elashry

2024 /June

Please put —√ on your best alternative's box and fill the blank spaces provided in some questions.

Part I: Demographic Characteristics

1. Gender: Male ☐ Female ☐
2. Age: less 25 ☐ 25-35 ☐ 35-45 ☐ Over 45 ☐
3. Educational qual: High school ☐ Diploma ☐ Bachelor ☐ Master and above ☐
4. Working Experience: < 5 year ☐ 5 -10 ☐ 10 -20 ☐
<20 ☐
5. Position: Manager ☐ Supervisor ☐ Coordinator ☐ Technician ☐
Driver ☐ Others ☐

Part II: Project operational Performance

To what extent have the following operational performance dimensions been practiced in your organization?

Operational performance dimension measure ranging from:

1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree as shown below.

No	Items	1	2	3	4	5
	Cost					
1	The company focuses on reducing transportation cost					
2	The Company aims at reducing warehousing cost					
3	The company focuses on reducing labor costs					
4	The company seeks to reduce operating expenses					
5	The company focus to increase fuel saving					
6	The company seeks lower insurance premiums					
	Flexibility					
7	The company looks at provision of a variety of services					
8	Company seeks to offer readily available services					
9	The company aims at volume flexibility					
10	Company looks at mix flexibility					
	Service Quality					
11	The company looks to achieve high customer loyalty					
12	Company looks at increasing the number of customers					
13	The company focuses on reducing emissions					
	Speed of Service Delivery					
14	The company seeks to improve communication					
15	The company aims at high service rates					
16	The company keeps up to date procurement information					
17	The company looks at reducing lead time					

Part III: Fleet Maintenance Management

The following questions are about how your organization has been implementing fleet management on operational performance. Please indicate the level of your agreement or disagreement using (✓) on the following statements based on your experience in your company on fleet management practices.

The rating is from 1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree as shown below.

No	Items	1	2	3	4	5
	Vehicles Repair and Maintaining Practice					
1	The organization has successful vehicles repair and maintenance control system					
2	The organization has regular Vehicle servicing time schedule					
3	The organization has well organized control mechanism for genuine spare part used for vehicle service and maintenance					
4	The repair and maintenance garage complete the service and maintenance on time					
5	Drivers of the organization gives proper feedback for fleet department about service and maintenance of the assigned vehicle					
6	The fleet department of the organization handles complaint regarding service and maintenance appropriately					
	Fuel Management System					
7	The organization is successful in overall fuel management system					
8	The organization has set a standard on fuel consumption rate per vehicle					
9	The organization allocates enough fuel coupons for field missions					
10	There is a timely follow up for fuel consumption					
11	The organization allocate sufficient budget for fuel cost					
	Vehicle replacement and Disposal Management					
12	The organization is using the vehicle tracking system for fleet management					
13	The organization has modern technology of GPS for vehicle tracking system					
14	The organization has installed vehicle tracking system on all organization vehicles					
15	The organization assigned a person to monitor and manage the GPS tracking system					
16	The organization supervises speed limit by GPS tracking system					
17	The organization used the Tracking system to manage fuel consumption and maintenance scheduling					

	Driver training and Management					
18	The organization has well-organized supervision method on drivers					
19	The organization has well-organized drivers mission assignment system					
20	The organization has assigned a responsible officer for handling drivers' mission assignment					
21	There is a habit to motivate/reward an exemplary driver					

Thank you for your time & all your answers are important and supportive for my research!

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PC1	56.95	364.827	.769	.890	.972
PC2	56.95	365.266	.896	.892	.970
PC3	57.05	373.412	.715	.872	.972
PC4	57.00	369.756	.790	.901	.971
PC5	56.90	371.113	.759	.841	.972
PC6	56.95	370.534	.746	.903	.972
PF1	57.02	365.975	.864	.825	.970
PF2	57.00	362.780	.905	.938	.970
PF3	57.21	364.855	.863	.940	.970
PF4	57.31	371.195	.854	.912	.970
PS1	56.83	360.776	.843	.886	.970
PS2	56.83	358.435	.905	.924	.970
PS3	57.60	382.198	.527	.653	.975
PD1	57.14	360.369	.844	.921	.970
PD2	56.95	362.534	.879	.944	.970
PD3	57.02	367.926	.782	.802	.971
PD4	57.17	365.703	.868	.897	.970

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
FV1	72.48	624.597	.738	.	.982
FV2	72.45	616.059	.883	.	.981
FV3	72.45	614.059	.846	.	.981
FV4	72.38	620.973	.812	.	.981
FV5	72.69	618.463	.802	.	.982
FV6	72.43	615.178	.890	.	.981
FF1	72.76	615.698	.921	.	.981
FF2	72.90	614.820	.869	.	.981
FF3	72.93	613.580	.866	.	.981
FF4	72.86	625.052	.781	.	.982
FF5	72.98	611.243	.891	.	.981
FM1	72.62	608.973	.894	.	.981
FM2	72.60	609.320	.903	.	.981
FM3	72.81	608.890	.872	.	.981
FM4	72.88	612.205	.844	.	.981
FM5	72.83	608.191	.881	.	.981
FM6	72.57	616.056	.862	.	.981
FD1	72.98	614.073	.894	.	.981
FD2	73.10	616.625	.842	.	.981
FD3	72.83	611.313	.857	.	.981
FD4	73.10	629.503	.585	.	.983

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.971	70.416	70.416	11.971	70.416	70.416	6.798	39.987	39.987
2	1.734	10.198	80.614	1.734	10.198	80.614	5.490	32.293	72.280
3	.775	4.558	85.172	.775	4.558	85.172	2.192	12.892	85.172
4	.540	3.177	88.349						
5	.508	2.988	91.337						
6	.274	1.613	92.951						
7	.244	1.437	94.387						
8	.235	1.382	95.769						
9	.140	.825	96.594						
10	.127	.745	97.339						
11	.108	.633	97.972						
12	.095	.562	98.534						
13	.074	.433	98.966						
14	.066	.388	99.354						
15	.052	.307	99.661						
16	.034	.202	99.863						
17	.023	.137	100.000						

Extraction Method: Principal Component Analysis.

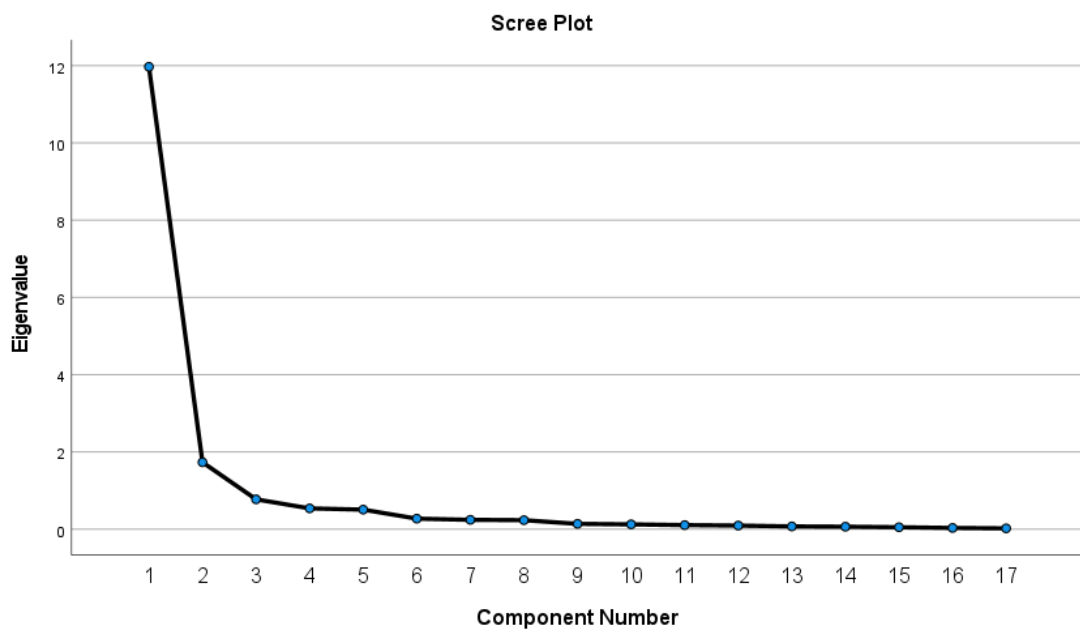
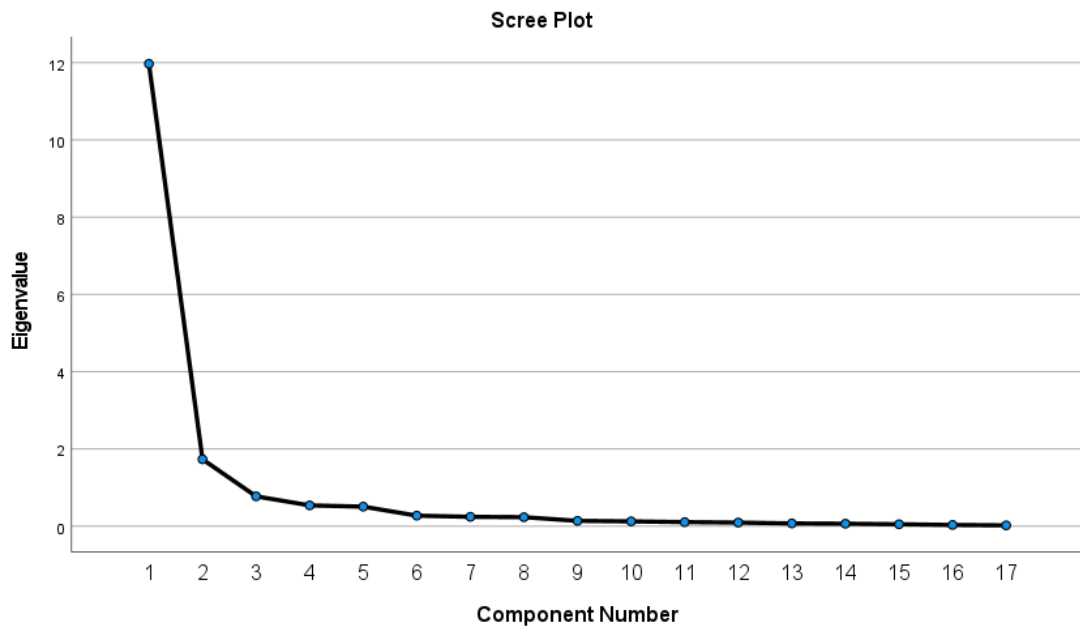


Figure 5: simulation results of the three maintenance strategies