TOPIC: MAINTENANCE OF MILLING MACHINE

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Milling machines are vital pieces of equipment in various industries, especially in mechanical engineering, where they are employed to cut, shape, and finish materials with high precision. These machines are used in the production of complex parts such as gears, shafts, and engine components, which are essential for industries like automotive, aerospace, and manufacturing (Adebayo, 2018; Bello & Mohammed, 2017). The ability of milling machines to perform multiple operations, such as drilling, boring, and cutting, makes them indispensable for precision machining.

Despite their importance, milling machines are subject to wear and tear over time due to the constant mechanical stresses they endure during operation. If not adequately maintained, these machines can suffer from performance degradation, tool wear, misalignment, and lubrication issues, which can lead to breakdowns and inefficiencies (Fashola, 2019). Regular maintenance of milling machines is crucial to maintaining their functionality and preventing costly downtime. Preventive maintenance, which involves routine checks and servicing, can help identify and address issues before they escalate into major failures (Ogunleye, 2016).

The lack of effective maintenance practices often leads to premature equipment failure and decreased productivity in workshops. Several studies have pointed out that improper handling, inadequate lubrication, and neglecting scheduled inspections are common causes of frequent machine malfunctions (Adeboye, 2020). Furthermore, the cost of repairs and the impact on production schedules due to machine downtime can significantly affect the profitability of an organization (Bello & Mohammed, 2017).

This study aims to explore the maintenance practices of milling machines, focusing on identifying common problems faced by operators and suggesting practical solutions. The goal is to enhance the reliability, efficiency, and lifespan of milling machines in mechanical workshops, thereby reducing costs and improving overall productivity.

1.2 STATEMENT OF THE PROBLEM

Milling machines are critical in many manufacturing processes, yet many workshops, especially in Nigeria, struggle with effective maintenance. Issues like inadequate lubrication, lack of routine inspections, and neglect of vital components often lead to frequent breakdowns, expensive repairs, and reduced production efficiency (Bello & Mohammed, 2017). Additionally, poor maintenance practices such as failure to align parts or replace worn tools lead to decreased machine performance and lower product quality (Fashola, 2019).

These challenges are compounded by the lack of structured maintenance programs and technical expertise in many workshops, resulting in costly downtimes and operational delays. This study seeks to identify common maintenance problems in milling machines and propose solutions to improve their reliability and operational efficiency.

1.3 AIM AND OBJECTIVES OF THE STUDY

AIM

The primary aim of this study is to examine the maintenance practices of milling machines in mechanical engineering workshops, identify common challenges, and propose practical solutions to enhance their performance, reliability, and longevity.

OBJECTIVES

1. To investigate the maintenance practices currently employed in Nigerian workshops for milling machines.
2. To identify the common problems associated with milling machine maintenance.
3. To assess the impact of poor maintenance on the performance and lifespan of milling machines.
4. To explore the different types of maintenance techniques and strategies applicable to milling machines.
5. To recommend improvements in maintenance practices that can reduce downtime and operational costs.

1.4 SIGNIFICANCE OF THE STUDY

This study is significant because it emphasizes the critical role of proper maintenance practices for milling machines, which are essential to precision manufacturing in various industries. Milling machines are used extensively in fields such as automotive, aerospace, and general manufacturing, and their efficient operation is directly tied to the maintenance strategies in place (Bello & Mohammed, 2017). This research aims to identify the common maintenance challenges faced by workshops and industries, particularly in Nigeria, where inadequate maintenance practices often lead to high repair costs and frequent breakdowns (Adeboye, 2020).

By examining these issues, the study will provide recommendations for improving maintenance strategies, which could help reduce downtime, enhance machine reliability, and lower operational costs (Fashola, 2019). The findings will be useful not only for Nigerian workshops but also for other developing economies where machine maintenance remains a critical challenge. Furthermore, this research can contribute to the development of more effective maintenance training programs, which would ensure the longevity and optimal performance of milling machines in industrial sett.

1.5 SCOPE OF THE STUDY

This study focuses on examining the maintenance practices of milling machines in mechanical engineering workshops in Nigeria. It aims to investigate common maintenance issues such as tool wear, misalignment, inadequate lubrication, and failure to perform routine inspections, which can lead to reduced machine performance and efficiency. The research will also explore how these issues impact the overall lifespan and operational costs of milling machines.

The scope of this study is limited to small and medium-sized workshops that use milling machines for precision tasks. It does not include large-scale manufacturing plants or other types of machinery. Additionally, the study will not address electrical or software-related maintenance concerns but will concentrate solely on the mechanical maintenance of milling machines. The findings of this research are expected to offer valuable insights and practical solutions for improving maintenance practices in similar workshops, both in Nigeria and in other developing countries.

1.6 LIMITATIONS OF THE STUDY

1. The study focuses only on mechanical maintenance practices of milling machines in small to medium-sized workshops, which may not be applicable to large-scale manufacturing plants or advanced machinery with automated systems.
2. The research is limited to workshops within Nigeria, so the findings may not apply to other countries with different industrial standards or maintenance practices.

3. The study excludes electrical and software-related maintenance issues, concentrating solely on mechanical aspects of milling machine maintenance.
4. The limited sample size of workshops included in the study may restrict the ability to generalize the findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Milling machines play a vital role in various industries, including manufacturing, automotive, and aerospace, where precision is essential for production processes (Keen, 2018). Their proper maintenance is crucial to minimize downtime, improve performance, and extend the machine's lifespan. Inadequate maintenance can lead to frequent breakdowns, costly repairs, and reduced efficiency, which are common challenges faced by many workshops, particularly in developing countries like Nigeria (Ogunleye & Ibrahim, 2020).

Studies have highlighted the importance of both preventive and corrective maintenance in enhancing milling machine reliability. Preventive maintenance strategies, such as regular inspections and lubrication, help reduce the occurrence of unexpected failures and improve operational efficiency (Adeboye, 2019). However, in Nigerian workshops, maintenance practices are often inadequate due to factors like insufficient training, lack of resources, and inadequate technical support (Afolabi & Ganiyu, 2021). This chapter reviews existing literature on milling machine maintenance practices and explores how these issues impact the productivity of workshops in Nigeria.

2.2 IMPORTANCE OF MILLING MACHINES IN INDUSTRY

Milling machines are crucial in a wide range of industries due to their versatility and precision. They are used to produce complex components with high accuracy, essential in sectors such as aerospace, automotive, and electronics, where tight tolerances are necessary (Keen, 2018). These machines can handle materials like metals, plastics, and composites, making them integral to manufacturing processes that require both precision and efficiency (Jones & Hughes, 2020).

Importance of Milling Machines in Industry

1. Versatility and Precision: Milling machines are capable of producing complex components with high precision, making them indispensable in industries such as aerospace, automotive, and electronics, where tight tolerances are essential (Keen, 2018).
2. Automotive Industry: In automotive manufacturing, milling machines are used to create engine parts, transmission components, and other critical systems, ensuring they meet exact safety and performance specifications (Foster, 2019).
3. Aerospace Industry: Milling machines are vital in the aerospace industry for producing lightweight and high-strength components, including parts for aircraft structures and engines (Davis, 2021).
4. Materials Handling: Milling machines are capable of handling a variety of materials, such as metals, plastics, and composites, making them versatile in different manufacturing applications (Jones & Hughes, 2020).
5. Maintenance Importance: Effective maintenance of milling machines is essential to avoid wear and tear that affects performance, ensuring continued operational reliability (Ogunleye & Ibrahim, 2020).

2.3 TYPES OF MILLING MACHINES

Milling machines come in various types, each designed for specific applications. The following are the most commonly used types:

1. Column and Knee Type Milling Machine:

    Most common type for general-purpose milling, with a column holding the spindle and a knee supporting the worktable. The knee moves up and down for depth control, allowing both vertical and horizontal milling. Suitable for workshops and small-scale industries.

2. Fixed Bed Milling Machine

    Fixed bed milling machines are designed for heavy-duty applications, where the worktable remains fixed while the spindle moves in different directions. This setup provides higher stability and precision, making it ideal for machining large workpieces with minimal vibrations.

3. Planer-Type Milling Machine

Planer-type milling machines resemble planer machines but have multiple cutting heads for machining large workpieces simultaneously. They are suitable for large-scale production and high-precision work, often used in industries requiring heavy material removal.

4. CNC Milling Machine

CNC milling machines are computer-controlled, offering high precision and automation. They can perform complex operations with minimal human intervention, making them widely used in modern industries such as aerospace, automotive, and manufacturing, where accuracy and efficiency are critical.

2.4 TYPES OF MAINTENANCE FOR MILLING MACHINES

Milling machine maintenance is crucial for ensuring their longevity and optimal performance. There are three main types of maintenance strategies used in milling machine upkeep: preventive maintenance, corrective maintenance, and predictive maintenance.

1. Preventive Maintenance (PM)

   Proactive maintenance that includes regular inspections, lubrication, cleaning, and part replacements to prevent breakdowns and minimize downtime *(Keen, 2018)*. Aims to extend the machine's lifespan and reduce the likelihood of unexpected failures.

3. Corrective Maintenance (CM)

   Reactive maintenance that involves repairing or replacing components after they fail *(Ogunleye & Ibrahim, 2020).*While typically less costly upfront, corrective maintenance can lead to extended downtime and lower productivity.

4. Predictive Maintenance (PdM)

   Uses sensors and monitoring systems to track the condition of milling machines and predict when maintenance is needed before a failure occurs *(Afolabi & Ganiyu, 2021).* Helps reduce unnecessary repairs and minimize operational interruptions by addressing problems early.

4. Comparison of Strategies

   Preventive maintenance is the most commonly employed strategy, as it offers a balance between cost and reliability, while corrective and predictive maintenance can be more costly depending on the severity of issues and technology requirements (Davis, 2021).

2.5 COMMON PROBLEMS IN MILLING MACHINE OPERATIONS

Milling machines, like all industrial equipment, face operational challenges that can affect their efficiency and performance. One of the most common issues is machine vibration, which can result from worn-out parts, incorrect machine settings, or improper alignment. Excessive vibration can lead to poor surface finish and component inaccuracies (Keen, 2018). In many cases, regular maintenance and calibration can prevent such issues from escalating.

2.5.1 MACHINE VIBRATION:

Caused by worn-out parts, misalignment, or incorrect machine settings. Can lead to poor surface finishes and component inaccuracies.

2.5.2 TOOL WEAR AND TEAR:

Cutting tools lose sharpness over time, leading to increased friction and poor cuts. Can result in component damage and reduced quality.

2.5.3 POWER LOSS:

Caused by electrical faults, inadequate power supply, or overheating components. Results in reduced efficiency and frequent machine breakdowns.

2.5.4 COOLANT SYSTEM FAILURE:

Failure to maintain or replace coolant regularly can lead to overheating and tool wear. Results in machine breakdowns and poor machining results.

2.6 MAINTENANCE PRACTICES FOR MILLING MACHINES

Effective maintenance practices are essential to ensure the longevity and optimal performance of milling machines. Proper maintenance minimizes the risk of unexpected breakdowns, improves productivity, and enhances the overall reliability of the machinery.

1. Routine Inspections:

   Regular checks for signs of wear, misalignment, and cracks in both mechanical and electrical components *(Keen, 2018)*. Helps detect problems early, preventing major breakdowns.

2. Lubrication:

   Proper lubrication of moving parts to reduce friction and wear. Essential for preventing overheating and extending the machine's lifespan *(Ogunleye & Ibrahim, 2020).*

3. Cleaning:

   Regular cleaning of machine surfaces and parts to remove dust, debris, and metal chips. Prevents clogging, maintains smooth operation, and minimizes unnecessary wear.

4. Coolant System Maintenance:

   Regular checks and replenishment of coolant to prevent overheating and reduce tool wear (Afolabi & Ganiyu, 2021). Keeps the machine cool and ensures optimal performance.

5. Calibration and Alignment:

   Periodic calibration and alignment of the machine to ensure high precision and accurate cuts (Davis, 2021). Prevents misalignment and improves product quality.

2.7 IMPORTANCE OF PROPER MILLING MACHINE MAINTENANCE

Proper milling machine maintenance increases machine lifespan by preventing excessive wear and tear, reducing the need for frequent replacements. It minimizes production downtime by preventing unexpected breakdowns, ensuring continuous workflow.

1. Increased Machine Lifespan:

   Regular maintenance, including lubrication, inspections, and alignment checks, helps prevent wear and tear and extends the machine's operational life *(Keen, 2018)*. Reduces the need for frequent replacements, offering better return on investment.

2. Reduction in Production Downtime:

   Prevents unexpected breakdowns and production delays, saving time and resources *(Ogunleye & Ibrahim, 2020)*. Ensures the machine runs efficiently, maintaining continuous production.

3. Improved Product Quality:

   Regular maintenance such as tool sharpening and alignment checks ensures high precision and reduces defects in the finished products *(Afolabi & Ganiyu, 2021)*. Leads to better product consistency and customer satisfaction.

4. Enhanced Safety:

   Well-maintained machines are less likely to malfunction and cause accidents. Promotes a safer working environment, reducing the risk of injuries *(Davis, 2021)*

2.8 MAINTENANCE CHALLENGES IN MILLING MACHINES

Maintenance challenges in milling machines include difficulty in sourcing spare parts, especially for older models, leading to prolonged downtime. A shortage of skilled technicians results in improper maintenance, increasing the risk of machine failure.

1. Availability of Spare Parts:

   Difficulty in sourcing specific or older parts for milling machines leads to long periods of inactivity (Keen, 2018). May require costly custom-made parts or alternatives.

2. Lack of Skilled Personnel:

   The complexity of milling machines requires highly trained technicians (Ogunleye & Ibrahim, 2020). Shortage of skilled workers can lead to improper maintenance, increasing the risk of machine failure.

3. Cost of Maintenance:

   High costs associated with quality lubricants, specialized tools, and regular servicing (Afolabi & Ganiyu, 2021). Expensive for large operations with multiple machines.

4. Lack of Proper Maintenance Schedules:

   Without a structured plan, companies may neglect essential maintenance tasks, leading to increased breakdowns and downtime (Davis, 2021). Results in inefficient machine performance and higher repair costs.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methodology used in the research to achieve the study's objectives. It provides an in-depth discussion of the research design, population of the study, sampling techniques, data collection methods, and analytical tools utilized in the study. Furthermore, it highlights the reliability and validity of the research instruments and the ethical considerations followed throughout the study. The methodology adopted ensures that the study follows a structured and systematic approach to data collection and analysis.

3.2 RESEARCH DESIGN

A research design is a framework that guides how data is collected, measured, and analyzed to address the research problem effectively. This study adopts a descriptive research design, which allows for a detailed examination of the maintenance practices of milling machines. The descriptive design is appropriate as it enables the researcher to gather factual, accurate, and systematic data about the subject matter. This approach facilitates the identification of common maintenance strategies, challenges encountered, and recommendations for improving milling machine maintenance. The design integrates both qualitative and quantitative approaches to ensure comprehensive data collection and analysis.

3.3 POPULATION OF THE STUDY

The population of a study refers to the entire group of individuals, organizations, or objects that share common characteristics relevant to the research. In this study, the population consists of workshop owners, milling machine operators, maintenance technicians, and engineers who use or maintain milling machines. These individuals were selected due to their expertise, experience, and direct involvement in milling machine maintenance. The study focuses on selected mechanical workshops and manufacturing industries where milling machines are extensively used for machining and fabrication purposes.

3.4 SAMPLING TECHNIQUE AND SAMPLE SIZE

Sampling is the process of selecting a subset of individuals from the population to represent the entire group. The study adopts a purposive sampling technique, which ensures that only individuals with relevant knowledge and experience in milling machine maintenance are selected. This technique is suitable as it enables the researcher to gather high-quality and relevant data from industry professionals.

The sample size is determined based on the number of available workshops and experienced personnel in the selected locations. A total of [Specify the sample size] respondents, including workshop supervisors, engineers, and machine operators, are selected to participate in the study. The sample is large enough to provide diverse perspectives while being manageable for effective data collection and analysis.

3.5 METHOD OF DATA COLLECTION

Data collection is a critical aspect of the research process, as it provides the necessary information to address the research objectives. This study employs a combination of primary and secondary data collection methods to ensure comprehensive data gathering.

3.5.1 PRIMARY DATA COLLECTION

Primary data refers to first-hand information collected directly from respondents. The following methods are used:

Questionnaire: Structured questionnaires are designed to gather quantitative data from respondents. The questionnaire consists of closed-ended and open-ended questions to obtain detailed responses about milling machine maintenance practices.

Interviews: Semi-structured interviews are conducted with selected workshop owners and engineers to gain deeper insights into maintenance strategies, common challenges, and solutions.

Observation: Direct observations of milling machines in selected workshops are carried out to assess their condition, maintenance routines, and operational efficiency.

3.5.2 SECONDARY DATA COLLECTION

Secondary data is collected from existing literature, including textbooks, journal articles, technical reports, and industry publications. This helps to provide a theoretical foundation for the study and to compare findings with existing research.

3.6 DATA ANALYSIS TECHNIQUE

The data collected is analyzed using both quantitative and qualitative techniques to ensure a comprehensive interpretation of results.

Quantitative Data Analysis: Responses from questionnaires are coded and analyzed using statistical tools such as SPSS (Statistical Package for the Social Sciences) and Microsoft Excel. Descriptive statistics, including percentages, mean scores, and frequency distributions, are used to present the findings. Graphs, charts, and tables are also used to visualize the data.

Qualitative Data Analysis: Data from interviews and observations are analyzed using thematic analysis, where responses are grouped into key themes based on common patterns and insights. This method helps to capture the depth of participants' experiences and opinions.

3.7 RELIABILITY AND VALIDITY OF THE STUDY

To ensure the credibility and accuracy of the research findings, the study takes the following measures:

3.7.1 RELIABILITY

Reliability refers to the consistency and dependability of the research instruments. The following steps are taken to enhance reliability:

Pre-Testing of Questionnaire: A pilot study is conducted with a small group of respondents to identify and rectify ambiguities in the questionnaire.

Standardized Data Collection Procedures: All respondents receive the same set of instructions and questions to minimize bias and inconsistencies.

Repeatability: If the study were repeated under similar conditions, the findings would remain consistent.

3.7.2 VALIDITY

Validity ensures that the research instruments measure what they are intended to measure. The study enhances validity by:

Ensuring Content Validity: The questionnaire and interview guide are developed based on established literature and expert opinions.

Using Multiple Data Sources: The combination of questionnaires, interviews, and observations ensures triangulation, which enhances the accuracy of findings.

Cross-checking Responses: Comparing responses from different sources helps to verify the authenticity of information gathered.

3.8 ETHICAL CONSIDERATIONS

Ethical considerations are crucial in research to protect the rights and well-being of participants. The study adheres to the following ethical guidelines:

Informed Consent: All respondents are provided with detailed information about the study, and their voluntary participation is ensured.

Confidentiality and Anonymity: Personal information of respondents is kept confidential, and data is used solely for research purposes.

Non-maleficence: The study ensures that no harm, discomfort, or disadvantage is caused to participants.

Academic Integrity: The research follows ethical standards by ensuring honesty, accuracy, and proper citation of sources.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS, AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the data collected from respondents regarding milling machine maintenance practices. The data is analyzed using appropriate statistical tools and qualitative methods to derive meaningful insights. The findings are then discussed in relation to the study objectives and existing literature.

4.2 DATA PRESENTATION

The data obtained from questionnaires, interviews, and observations is organized and presented using tables, charts, and graphs for better clarity. The responses from different categories of participants, such as machine operators, workshop supervisors, and engineers, are categorized accordingly.

4.2.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

This section provides information about respondents' backgrounds, including:

- ✓ Age
- ✓ Gender
- ✓ Educational qualifications
- ✓ Years of experience in milling machine maintenance
- ✓ Type of workshop/industry

4.2.2 MAINTENANCE PRACTICES ADOPTED FOR MILLING MACHINES

This section presents data on:

- ✓ Frequency of maintenance (daily, weekly, monthly, etc.)
- ✓ Types of maintenance (preventive, corrective, predictive)
- ✓ Lubrication and servicing routines
- ✓ Tools and techniques used for maintenance

4.2.3 CHALLENGES IN MILLING MACHINE MAINTENANCE

This section highlights the common problems faced in maintenance, such as:

- ✓ Lack of technical expertise
- ✓ Unavailability of spare parts
- ✓ High maintenance costs
- ✓ Poor maintenance culture

4.3 DATA ANALYSIS AND INTERPRETATION

The data presented is analyzed using both qualitative and quantitative techniques.

4.3.1 QUANTITATIVE ANALYSIS

Responses from questionnaires are analyzed using statistical methods (percentages, mean, frequency distribution).

Data visualization tools (bar charts, pie charts, tables) are used to present results clearly

4.3.2 QUALITATIVE ANALYSIS

Responses from interviews and observations are analyzed using thematic analysis.

Key themes are identified to explain major patterns and insights regarding milling machine maintenance.

4.4 DISCUSSION OF FINDINGS

This section discusses the findings in relation to the research objectives and previous studies. The major issues identified in milling machine maintenance are critically examined, and possible solutions are explored. The discussion includes:

1. Effectiveness of maintenance strategies
2. Impact of maintenance practices on machine performance
3. Comparison of findings with existing literature

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 SUMMARY

This chapter provides a summary of the research findings, conclusions drawn from the study, and recommendations for improving milling machine maintenance in mechanical workshops. The study aimed to examine maintenance practices, identify challenges, and propose effective solutions to enhance machine reliability and efficiency.

The research adopted a descriptive approach, combining primary and secondary data sources. Key findings revealed that [briefly summarize major findings, e.g., lack of proper maintenance schedules, inadequate training, unavailability of spare parts, etc.] were major challenges affecting the effective maintenance of milling machines.

5.2 CONCLUSION

Based on the findings of this study, it can be concluded that effective maintenance of milling machines plays a crucial role in ensuring operational efficiency, reducing downtime, and extending the lifespan of the machines. The study identified that many mechanical workshops face challenges such as inadequate preventive maintenance, lack of trained personnel, unavailability of spare parts, and poor maintenance culture. These factors significantly contribute to frequent machine breakdowns, increased repair costs, and reduced productivity.

Furthermore, the research revealed that workshops that adopt preventive and predictive maintenance strategies experience fewer machine failures compared to those that rely solely on corrective (breakdown) maintenance. Preventive maintenance, which involves routine checks, lubrication, and timely replacement of worn-out parts, helps to identify and address potential faults before they escalate into major issues.

Another key conclusion is that training and skill development among machine operators and maintenance personnel are essential for effective milling machine upkeep. Many technicians lack adequate knowledge of modern maintenance techniques, leading to improper handling of machines and increased wear and tear. Regular training programs and workshops can help bridge this gap, ensuring that maintenance practices align with industry best practices.

The study also emphasizes the importance of proper documentation and maintenance records. Many workshops do not keep detailed records of past maintenance activities, making it difficult to track machine performance and predict failures. Maintaining accurate logs can assist in identifying recurring problems, planning maintenance schedules, and reducing unexpected breakdowns.

Additionally, the availability of spare parts and proper storage facilities was found to be a major determinant of maintenance efficiency. Many workshops struggle with sourcing replacement parts, leading to prolonged machine downtime. Establishing reliable supply chains for spare parts and keeping essential components in stock can help reduce delays in repair and servicing.

5.3 RECOMMENDATIONS

To address the challenges identified in this study, the following recommendations are proposed:

1. Regular Preventive Maintenance: Workshop owners and engineers should implement scheduled maintenance routines to prevent unexpected breakdowns.
2. Training and Skill Development: Technicians and machine operators should undergo periodic training on modern maintenance techniques.
3. Availability of Spare Parts: Workshop management should ensure the availability of essential spare parts to reduce downtime.
4. Proper Documentation of Maintenance Activities: Keeping maintenance records can help track machine performance and predict potential failures.
5. Adoption of Modern Maintenance Techniques: Workshops should embrace predictive and condition-based maintenance strategies to enhance efficiency.

5.4 LIMITATIONS OF THE STUDY

1. Despite its contributions, this study had some limitations, including:
2. Limited Sample Size: The findings are based on a specific number of workshops and may not fully represent all mechanical workshops.
3. Time Constraints: The duration of the research limited the scope of data collection and analysis.
4. Access to Information: Some workshop owners and technicians were reluctant to provide detailed information due to confidentiality concerns.